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Bomb rack assemblies at the El Segundo Plant of the Douglas Aircraft Company, Inc.

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A Study of Possible Glider Uses in Commercial Operations

ALBERT E. BLOMQUIST*

Eastern Air Lines, Inc.

Introduction

The experience gained in the design and utilization of gliders for military operations is sufficient to indicate the possible commercial applications of gliders and to establish the design criteria for cargo gliders.

The glider can be employed to expand the limits of efficient performance of a majority of the present and future transport aircraft and can, when used in conjunction with properly designed tugs and pickup gear, bring the advantages of air transportation to vast areas not now served by any well-developed net of either ground or air transport.

A casual review of the transportation nets of various sections of the world indicate that only the United States and parts of Canada, England, and Europe are blessed with fairly well-developed systems of communications and transportation. In China, other sections of Asia, parts of Russia, Australia, Africa, and Central and South America, the road and rail nets are not well developed, and air transport has brought service to only a small segment of the areas that could be served efficiently by air.

There have been some instances of the use of air transportation to open hitherto inaccessible areas, particularly in Central and South America and Canada. In no case has this means of transport been properly exploited or have gliders been considered as a means of efficient air operations in difficult terrain.

Military developments have been carried to a point where the different techniques of towed flight, free flight, landings in restricted areas, and pickup are well defined. The information available on military operations, when coupled with a thorough knowledge of existing types of air service, can be used as a basis for determining the application of gliders to commercial transportation requirements.

It is not the purpose of this paper to present a detailed analysis of glider uses. Such a presentation would take considerable research. It is proposed, however, to present a review of possible applications of air-train operations to commercial air transportation which can be used as a guide to further investigations of the subject.

Presented at the National Air Transport Meeting, I.A.S., Washington, D.C., October 20, 1944.

* Transportation Engineer.

Use by Common Carriers

Air lines are granted certificates of necessity and convenience that permit operations over a given route and for service to certain cities on that route. Most domestic airways are 20 miles in width. Within these route boundaries are large numbers of cities and towns which do not have the benefits of the air service that passes overhead.

The logical assumption is that an air line should provide service to all, or at least a majority, of the communities along its routes if it is to give the greatest possible service of which it is capable. For instance, most trunk lines today serve only a small percentage of the cities located along their routes. Present service represents only 10 per cent of the cities that are large enough to justify regular scheduled air service, to say nothing of the large number of small communities with manufacturing facilities that should also receive some type of air service.

If an attempt were made to provide the majority of the deserving cities on these routes with the same type of air service that is now provided to most intermediate air-line stops, the costs of providing the necessary airports and other facilities would be prohibitive.

Local Service

Ample service could be provided each of these cities through the use of cargo gliders and pickup aircraft. There are many advantages inherent in air-train operations and in the use of pickup-equipped cargo aircraft that are applicable to this example. There would be no need to carry out extensive construction programs for airports, and it would be possible to develop the potential air traffic of these communities before spending large sums for ground installations. The use of these techniques would enable an air line to provide a comprehensive mail and cargo service to a majority of the smaller communities with a minimum initial expense and without the delay inherent in setting up the conventional type of operations.

The cargo aircraft equipped with pickup gear can perform multiple tasks. These craft can be used on scheduled dead-weight pickup operations to carry mail and express and pick up and deliver dead-weight loads of 1,000 lbs. These same tugs can be employed to move glider trains between major collection centers and the smaller communities. These tug aircraft can also be used as straight cargo aircraft on local and limited service. The delivery of cargo gliders to the intermediate stations could be accomplished by almost any schedule that operated along the route, inasmuch as the transport could tow the glider to the proper release point and continue on its schedule while the glider landed at the intermediate station. There are certain weather conditions that would limit such air-train operations, but the recent developments in radio and radar aids and remote control devices should provide the means of reducing such weather hinderances to a minimum.

If cargo gliders are to be fully exploited, it will be necessary to move them from the small cities to the larger collection centers by pickup tugs. This could easily be accomplished by establishing a dispatching system that would have several pickup tugs on call to do unscheduled pickup and delivery.

Relieving Temporary Peak Loads

Cargo gliders could also be effectively employed to relieve temporary peak loads either between terminal and intermediate station, terminal and terminal, or two intermediate stations. In such cases the gliders could be attached to any passenger or cargo schedule, thereby providing the necessary additional capacity without having to provide the extra expensive powered aircraft for the intermittent and unpredictable peak periods.

Service Uses

There are a number of service uses of gliders that would be of material benefit in air-line operations. A mobile air-

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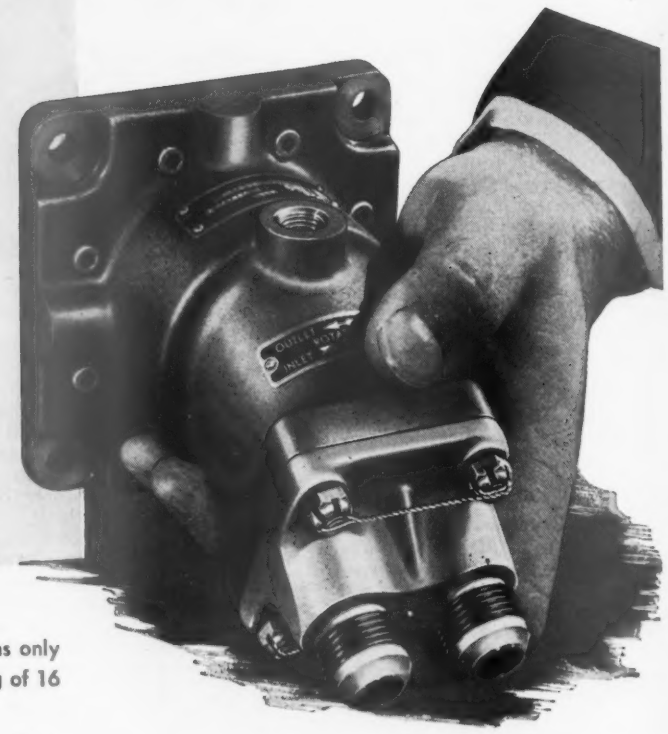

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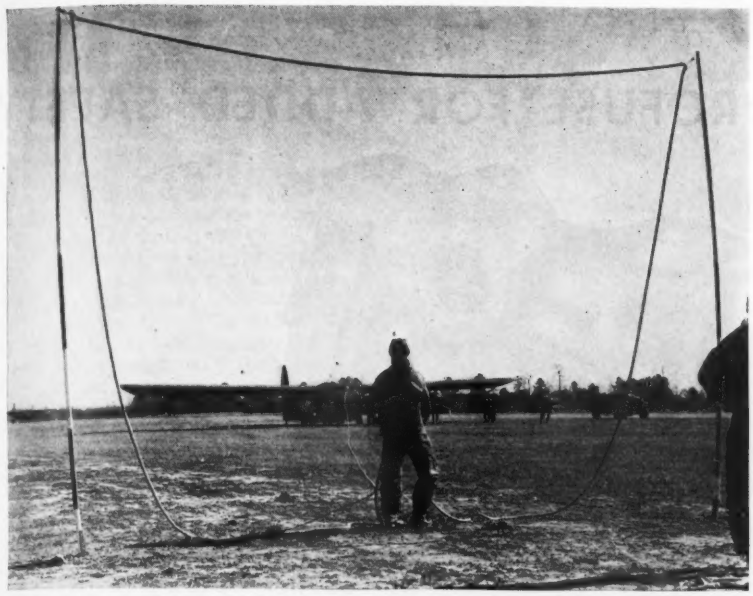

The CG-4A glider and station are readied for the pickup.

craft repair unit capable of completing major aircraft repairs could be installed in a glider to be stationed at a strategic point or at a major overhaul base and dispatched to any point along the system to handle mechanical failures or damaged aircraft. This mobile repair unit could move behind any regular schedule, and it would serve to reduce the loss of aircraft time that now occurs when aircraft are forced out of service away from a major overhaul base.

A glider maintenance unit capable of maintaining station facilities and equipment would provide an efficient means of maintaining stations and station equipment in first-class condition.

Advantages of the Air Train

There are a number of common aircarrier operations that can be more efficiently performed by glider trains than by present methods. A case in point is an operation now being performed in the Central Americas where an air line is moving large quantities of supplies, equipment, and personnel over a 70-mile route that traverses impassable terrain. This operation has been run with old cargo aircraft, and the records show that the aircraft spend a considerable proportion of the available flying hours on the ground being loaded and unloaded. Three cargo aircraft are employed in this one operation.

A study of the details of the weather, the daily tonnage requirements, and the types of cargo indicated the possibility of air-train operations. It was evident from the data at hand that one C-47 equipped with pickup gear plus five CG-4A gliders could more than meet the daily tonnage requirement. Neither the C-47 nor the CG-4A is considered to be the most suitable tug and tow aircraft, so the material increase in efficiency obtained with these craft could be improved with properly designed equipment.

In this particular instance the service was to a small airfield in the mountainous interior of the country in an area where there are many natural resources but relatively few sites for airports capable of handling cargo aircraft. Many of these known valuable properties can be reached by glider and can be profitably developed through the use of pickup aircraft and cargo gliders.

Moving Large Tonnages Short Distances

There are a number of advantages in the use of air-train technique for the movement of large tonnages over relatively short distances. One of the most important is the reduced capital structure required for an air-train operation as opposed to a straight air-cargo operation. In this case the relationship between tugs and gliders would be about 4 to 1. The use of gliders permits the tug aircraft to be air-borne practically all of the available flying hours. The use of gliders also permits the operation of the ground stations with fewer employees than would be possible under the present type of operations. The gliders can be left on the ground for loading and unloading for much longer periods of time than would be economically feasible for powered cargo aircraft.

The ability to pick up heavy dead weight permits the tugs to perform other types of service efficiently and adds to the economy of air-train operations.

The low capital investment, the small number of powered aircraft required with the inherent reduction in overhaul and maintenance costs, the reduced ground-installation costs, and the ability of air-train operations to give a much broader service make such an operation economical and ideal for the case mentioned previously.

Application of Air-Train Principles

The following hypothetic case will also serve to illustrate the advantage inherent in air-train operations:

The daily poundage to be delivered to a point 150 miles from the terminal is 20,000 lbs. There is an airport at the destination which will accommodate aircraft similar to the C-47 and, of course, cargo gliders. The time on the ground for the cargo aircraft at the terminal is 1 hour, and the time on the ground at the destination is $^1/_2$ hour. There is an aircraft available that could carry 5,000 lbs. per trip. There are gliders of 10,000-lb. pay-load capacity available that can be towed behind the

The Douglas C-47 towplane with hook and carrier arm dropped approaches in its pickup run.

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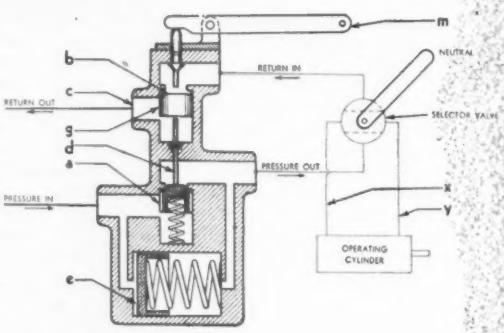
PRINCIPLE OF OPERATION



A check valve (a) is inserted in the pressure line between the power system and the selector valves. A displacement cylinder (e) is placed in parallel with the check valve (a) so that a sample of fluid may be discharged downstream from the check valve even though the valve be closed. When this sample is directed through a selector valve to an operating cylinder, it initiates movement of the piston in that cylinder thus displacing fluid from the other end. This returning fluid enters a small hydraulic cylinder (b) and moves its piston (g) before escaping through port (c) and to the reservoir. The motion of piston (g) is transmitted by push rod (d) to the check valve poppet and lifts it from its seat. Now that the check valve is held open fluid can flow through it and continue moving the operating cylinder piston. If the return line from the operating cylinder had been broken the sample would have moved the operating cylinder piston a small amount but the displaced fluid would have run out the break and thus not acted upon piston (g). Therefore, the check valve would not have been opened and flow of pressure fluid would have ceased as soon as the sample was used.

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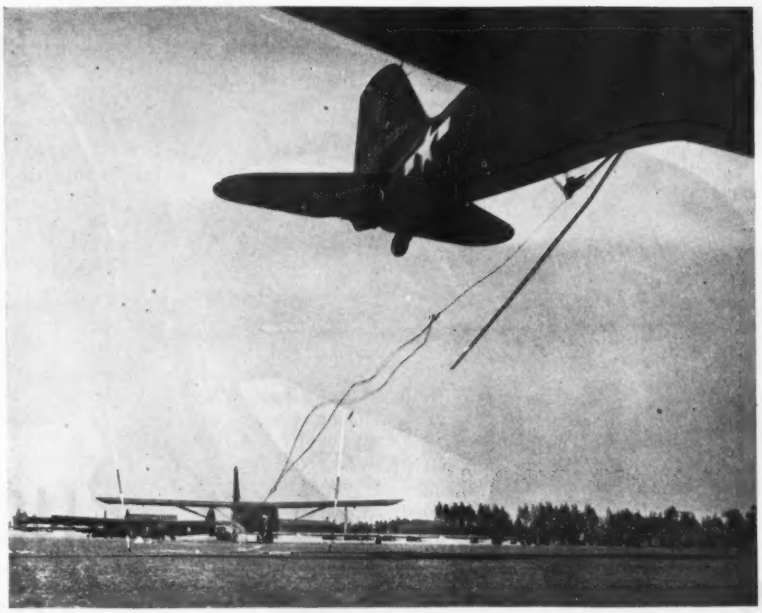
tug at a loss of only 10 per cent of the normal cruising speed of the tug.

The cargo aircraft operating alone can move the required poundage in 13 hours. The cargo aircraft operating as a pickup tug can move the same poundage in 4 hours and 50 min.

On the basis of a 13-hour flying day, the cargo aircraft utilized only 62 per cent of the flying hours when operating alone. Only 10 min. of the 4 hour and 50 min. air-train time were spent on the ground, so, on the basis of a comparable flying day, the air train could deliver 59,000 lbs. against the 20,000 lbs. delivered by cargo aircraft. These poundages represent only the amount delivered to the interior station. If capacity loads were available in both directions, one tug and three 10,000-lb. pay-load gliders could move 108,000 lbs. of cargo between these two points.



A pickup just after contact has been made. Note that the hook detaches from the arm.

Development by Air Trains

Many sections of the world owe whatever development they have experienced to the airplane and particularly to the small single-engined utility aircraft. In the Yukon and Alaska the isolated trapping and mining settlements were opened and maintained by the "bush" pilot. In the vast northern areas of Canada a network of air lines has helped to open a new frontier that bears great promise. In Colombia, Venezuela, Brazil, and other South American republics the local operators are opening the "back country" with their antiquated aircraft.

If it pays the rancher, the miner, the settler, and the trader, as well as the operator, to move cargo by the present inefficient aircraft, the application of air-train air transportation techniques to their problems would expand their opportunities beyond their fondest dreams. Not only would the people in these inaccessible areas have low-cost transportation, but they would also have the services that make for better living brought to their back yards. The ability of gliders to operate in and out of areas that are not even suitable for small powered aircraft should open many new sections in the Americas to development and permit the present air-line systems to set up a pickup and delivery service that would radiate from a majority of the trading centers now served by trunk-line operations.

Canadian Air-Train Service

The Canadian situation presents some interesting possibilities for such air-train service. Canadian Pacific Airways, for example, operates services from Edmonton north to a vast area rich in natural resources. There are less than 5,000 inhabitants in 1,000,000 square miles of this country. The activities of the entire area center around the few small communities served by the small aircraft that move everything from live stock to heavy mining equipment.

By using the present air-line stops as centers of operation for radiating glider pickup and delivery service, it would be possible to provide dependable low-cost transportation for the development of the substantial natural resources that are known to exist.

The climatic extremes of northern Canada and other undeveloped sections of the world should have less effect upon the development of these frontiers now that such tremendous strides have been made in the provision of mechanical aids to comfortable living. By the same line of reasoning it can be assumed that the introduction of air-train techniques to the present routine of air transportation would provide the key to the immediate opening of these frontiers.

Operational Possibilities in Russia

Russia, with one-sixth of the world's surface, contains virtually every material natural resource of modern civilization. This nation, with two and one-half times the area of the United States, has only 20 per cent of our railroad mileage and only 22 per cent more airway route mileage. The major portion of all of this transportation is concentrated in the western part of the country, less than 40 per cent by area, and even there the transportation nets are far from adequate.

The Siberian section of the country contains considerable mineral wealth and other vast natural resources, and yet it has only 10 per cent of the transport facilities. The terrain is of such a nature that air transportation appears to be the most efficient means of opening this section of Russia.

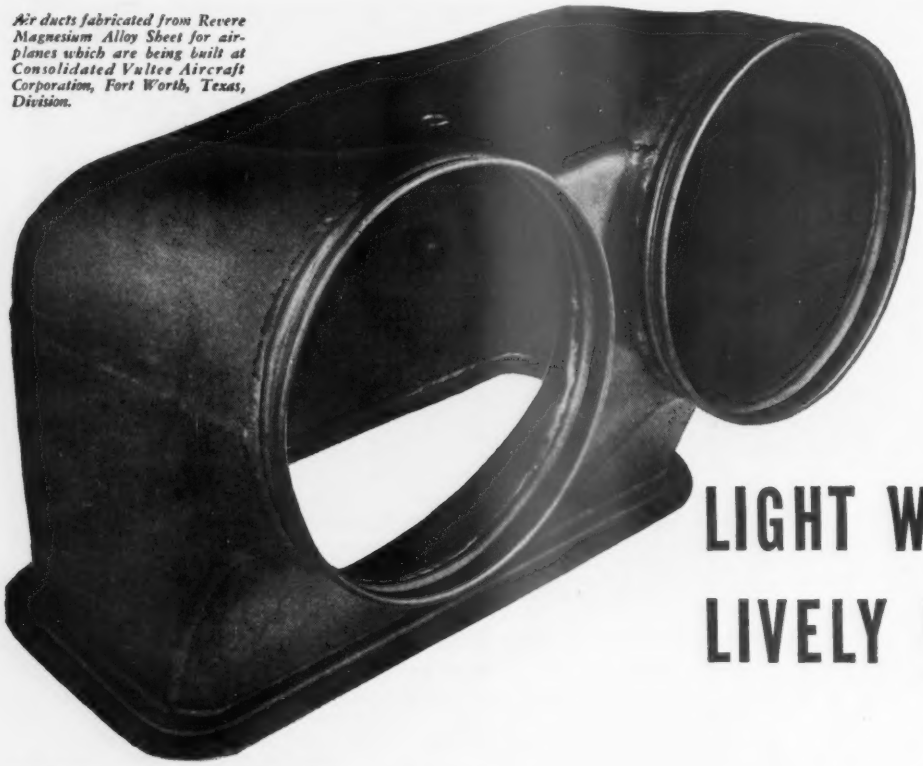
Scattered over the Siberian section of Russia are a number of trading centers of various sizes that serve vast areas of rich but undeveloped country. With the exception of those larger cities along the trans-Siberian Railroad, the major share of these trading centers are connected only by the most inadequate road and trail net. The terrain is mountainous and traversed by many rivers. These factors would tend to make the establishment of a satisfactory net of ground transport laborious and costly. Obviously, such a ground net must be completed eventually if the country is to be fully developed, but the difficulties of terrain need not deter the rapid progress of this development because of the availability of the new-found techniques of air transportation.

The scattered trading centers of Siberia could be linked by the conventional methods of air transport—non-stop, limited stop, and local cargo and passenger service. Such a system could be established at any time because most of the cities or towns in question have airports, radio facilities, a comprehensive meteorologic service, and other necessary ground facilities. This trunk-line service would provide an immediate answer to a portion of the transportation problems of this new frontier but would not provide the means of developing the resources of the country surrounding the trading centers. It is here that air trains and pickup could be so advantageously used.

Each city on the trunk routes can serve as the collection station and dispatching center for radiating pickup and delivery service to all points within a 200-mile radius. The lack of operating experience and direct contact with the territory and transportation requirements prevents an accurate analysis of each case. It is possible to demonstrate by example the transportation that can be provided by air-train operations.

The assumptions are as follows:

(1) There are 50 communities located within a 200-mile radius of a trunk-line center.



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(2) Each community requires two services a day.
(3) The average distance of all points to the trading center is 125 miles.
(4) The flying day is limited to 12 hours.
(5) The train speed block-to-block is 125 m.p.h.
(6) The cargo glider carries a 10,000-lb. pay load.
(7) The tug spends only 1 hour of each 12-hour flying day on the ground.

Necessary Equipment

Under the above conditions, 18 tugs and 35 gliders could provide the transportation needed to move 20,000 lbs. in each direction between the main line point and each of the outlying communities. This amounts to 7,500 ton-miles per tug per day, and, at an estimated direct cost of 40 cents per train-mile, the direct cost per ton-mile would be 8 cents. On the basis of the direct cost of 40 cents per air-train-mile, the total charges per mile would be about 65 cents. This would make the total ton-mile cost equal 13 cents. The above estimates are based upon a comparison of the cost of efficient tug-glider combinations and present operating experience of C-47 type aircraft in commercial operations and in military tug operations.

This is certainly an empiric solution to a problem of radiating pickup and delivery, but it has been developed from all of the available data and should be reasonably accurate, at least with respect to ton-mile costs.

Communications and Dispatching

Where a number of communities are involved, there would undoubtedly be a demand for an interchange of goods and mail between the outlying points, as well as between the trunk-line center and its satelites. Such an interchange might involve schedules and on-call dead-weight pickup service, as well as a comprehensive on-call glider service. If all flying equipment is to be employed to its fullest extent, a well-developed radio communications system and dispatching procedure must be employed. This would permit any station needing service (dead-weight or glider pickup) to advise the dispatching center, which would fit the request into the daily and hourly demand. The dispatchers would control the movement of the tugs on the basis of the demand sheets and job schedule of each tug.

Advantages of Air-Train Operation

In recapitulating the advantages of air-train operations as applied to radiating service, it is evident that (a) the costs of ground installations are negligible; (b) scheduled and on-call service can be given to any area having a cleared field 500 ft. wide by 1,000 ft. long; (c) equipment costs are low because of the small number of high-cost tugs required, and seasonal or emergency peaks can be provided for by low-cost aircraft; and (d) ground personnel can be kept to a low figure in comparison to the more conventional type of service.

Service Uses of Gliders

One of the principle advantages of glider service to an undeveloped or new section of country with few facilities and little or no ground transport is the amount of public service and convenience that can be provided for every family in the area. Gliders equipped as mobile first-aid and emergency hospitals and dental and health clinics can be readily moved on schedule or as desired. Emergency power plants, fire-fighting equipment, and disaster equipment can be set up in gliders as stand-by units at a central location to be picked up and quickly moved to the point of emergency.

It might be economically feasible to install mobile drug and grocery stores, as well as other types of merchandising units in gliders to be moved regularly from community to community. Even the cultural and entertainment needs of the area could be met through the use of gliders equipped as libraries or with projection units.

The same techniques could be applied to the tremendous transportation and development problems now facing China and her neighbors on the continent of Asia. The island empires of the Pacific would also benefit by the adaptation of air-train techniques to their transportation problems.

Cargo Possibilities

Some research work has been done on the movement of fresh food by air in the United States, and the studies indicate that the air transportation of perishables may develop into one of the largest single sources of traffic for either common or contract air carriers. Shortly before the war a survey was made on the air movement of food from Florida to Ohio. This survey revealed that bush-ripened strawberries could be moved by air at the prevailing air-express rates and still sell for only 1 cent more per box than those picked green and shipped by rail. The major advantage of the air movement of fresh foods is in the quality of the foods delivered. Because of the speed of air transportation, it is possible to ripen food on the tree or vine and still move it overnight from the ranches of the South or Southwest to the markets in the northern and eastern sections of the country. There is no comparison in taste between naturally ripened food and food picked green for shipping; consequently, there should be a big market for the vine-ripened produce.

Information presently available on this subject indicates that cargo gliders can be employed to improve the efficiency of moving food by air and to reduce the cost of this service. The ability of gliders to be landed and picked up from small cleared areas would permit the movement of foods directly from the fields or packing houses of Florida and other growing areas directly to the small communities or local distributing centers of the north. The savings effected would be extensive. Because the produce or fruit would not have to be rehandled en route, shipping costs and spoilage due to handling would be reduced.

Many foods are now picked prior to the last stage of ripening so that they will be firm enough to stand the journey to market. The vibration of powered cargo aircraft, while neither so severe nor so extended as that of trains and trucks, is still more than many types of ripe foods can stand. Gliders have no vibration, so it should be possible to move not only fully ripened fruits and foods that have been shipped green heretofore but also many types of delectable fruit that cannot stand extended journeys in the present types of transport.

The movement of food by air trains is only one phase of the possible application of gliders to contract air transportation. Preliminary studies have been made on the employment of gliders in the movement of raw materials and finished products, but they are not conclusive enough to indicate the full scope of air-train operations.

Suggested Design Criteria

The development of the various techniques and equipment of air-train operations has progressed to a point where future design and operating trends can be projected.

The governing factors in the design of gliders are: (a) the economical size of the pickup tug both from a performance and a cost standpoint, (b) the economical size of gliders from a performance standpoint, (c) the average cargo loads to be carried as measured by weight and volume, and (d) the limitations and desirability of multiple tow.

The design criteria of both the glider and the tug are interdependent because of their intimate relationship under all flight conditions and particularly during pickup operations.

The economical performance of the team has a great deal to do with the design of both the tug and glider.

A review of L.C.L. freight loadings and the data available on the average loading of highway carriers indicates that a cargo glider should have a pay load of approximately 10,000 lbs. and a cargo loading per square foot of floor space of 10 to 12 lbs.

The cargo compartment should have sufficient space to permit the rapid handling of cargo with the compartment so located that cargo can be manhandled onto the ground level, onto platforms, or into ground vehicles without the aid of mechanical devices. The cargo compartments should be so arranged that a single man or a small crew would have easy access to all parts of the compartments and to the tie-down points.

The landing gear should be extremely rugged to permit constant operation on unprepared fields.

The flying characteristics of the glider in towed and free flight determine the economic value of the train operations. The refinement of design plays as big a part as do the basic principles of aero-

(*Continued on page 37*)

. . . and here's how the integrated G-E armament system provides a tremendous increase in firepower with no increase in guns.

It is not that the Jap-blasting B-29 bristles with more guns. It doesn't—other bombers have carried as many.

The unprecedented combat stamina of the Boeing Superfortress is due to its *deadlier* fire-power. Deadlier because of its increased accuracy. Deadlier because it makes possible a more devastating concentration of fire *in any area*. Deadlier because it gives gunners greater comfort and safety.

The B-29 carries something entirely new in aircraft armament—the first remote-control system and the first completely integrated armament system to be applied to any production aircraft.

Begun in 1942

In response to the urgent call, early in 1940, for a power-operated turret, G.E. applied its newly developed amplidyne and its aircraft experience to work out an electrical system for locally controlled turrets.

Then, beginning in 1942, G.E. developed its new remote-control system for the B-29 and other new planes. Utilizing G-E amplidynes, selsyns, dynamotors, as well as G-E computers, turrets, and other equipment, these completely integrated systems are now also being built in enormous quantities.

Many Advantages

By providing extremely accurate, *remote* control of gunfire, the new G-E system has made it possible to locate sighting stations where they give gunners greater visibility, physical comfort, and armor protection. It has facilitated the placing of gunners in pressurized areas, and put them where noise and vibration are markedly less. All of these factors contribute much to the combat efficiency of gunners.

In addition, separation of sighting station from turret has resulted in less drag and better aerodynamic design. Highly important, too, the total weight of the new armament system is less than that of locally controlled armament now in use.

We at G.E. are proud of the part this new gunfire-control system is playing to hasten V-Day. We are proud of it, too, as an outstanding example of how, in peacetime, G-E "can do" will make planes more economical, and easier and safer to fly. *General Electric Company, Schenectady 5, N. Y.*

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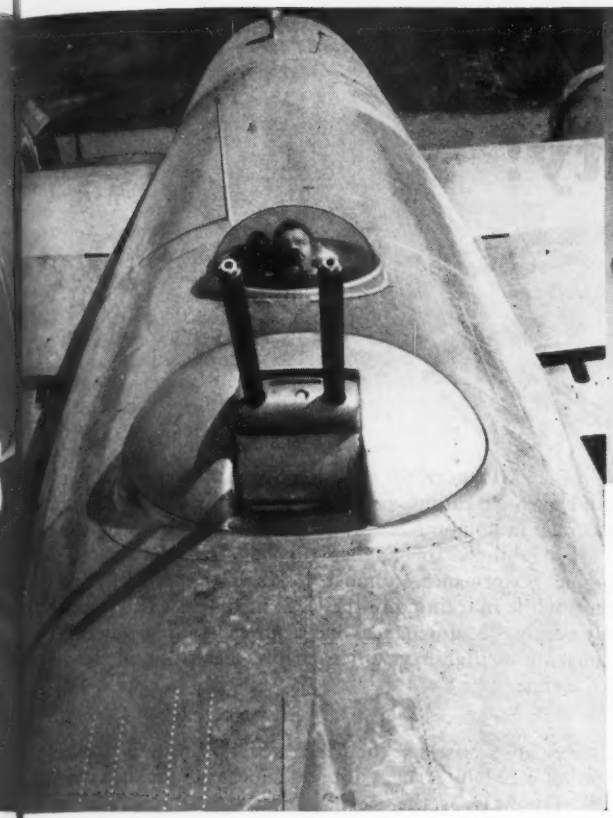
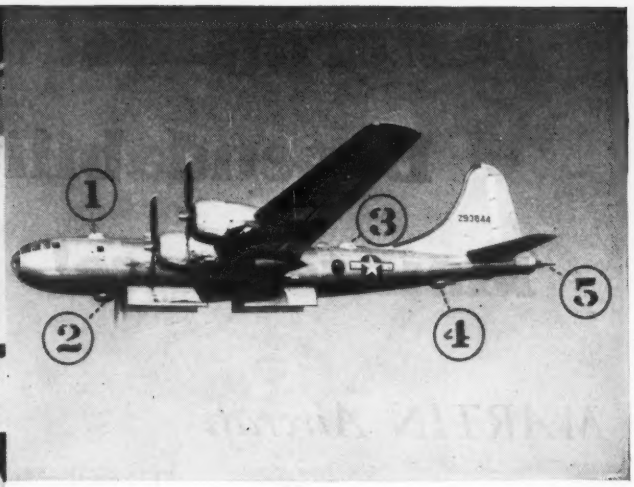
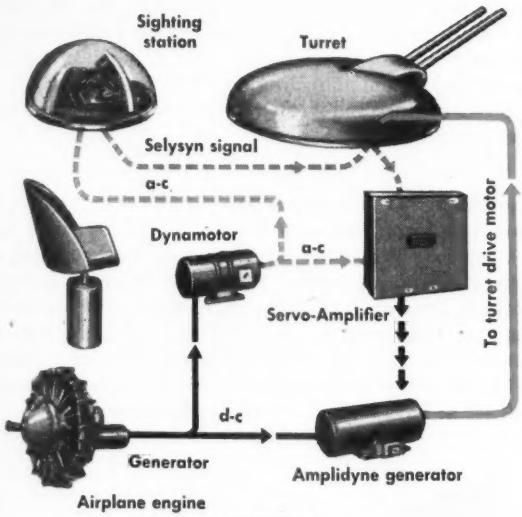




● (opposite page) The tail turret of the Boeing B-29 Superfortress mounts a 20-mm cannon flanked by two 50-caliber machine guns. All are controlled electrically from the compartment above the turret.

● (left) Rear top turret of the Superfortress with two 50-caliber machine guns. Forward of the turret is the sighting station from which these guns are controlled.

● (above) The five turrets on the B-29 are so located that several guns can be concentrated in any direction.



IT'S A SYSTEM!

This diagram shows, simply, how the system works in controlling guns in elevation. Another amplidyne and set of position-indicating devices are used to provide similar control in azimuth.

Assume the gunner raises his sight. Immediately, there is a "difference" between the elevation selsyn transmitter and receiver, resulting in a minute electric signal. This signal is instantly amplified by the electronic servo-amplifier. It is then magnified again by the amplidyne into "working power" which energizes the turret drive motor, causing it to turn. As the guns come into the desired position, the signal fades out, and the motor stops.

Although there are several electrical "steps" involved, the response of the guns is practically instantaneous. So smoothly do the guns follow the sight that guns and gunner seem one.

Other G-E engineered systems include d-c and a-c power supply equipment, engine temperature control, high-tension ignition, automatic cowl-flap positioning, and the electric-gyro automatic pilot.

PRECISION PRODUCTS AND ENGINEERED SYSTEMS FOR AIRCRAFT

Performance!

Dependability!

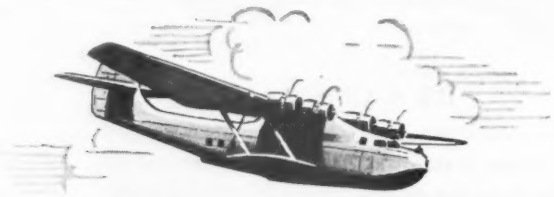
Maintenance!

MARTIN Aircraft Excel in All 3!

TAKE the Martin B-26 Marauder, for example. Speed of over 300 m.p.h., the firepower of eleven .50 calibre guns, heavy bombload, plus a record for exceptional accuracy in bombing . . . all these establish her outstanding performance. In dependability, there's her rugged strength, structural soundness, one-engine performance. Combat losses have been only four-tenths of one percent, while in training in the U. S. in 1943 she had the best safety record of any bomber. Maintenance? She requires less than any other bomber. Result: amazing availability which enables her to be in the air well over 80% of the time.

THESE same features are stressed in the Martin Mars. For performance, there's her record of 4,227 miles, non-stop; on another flight she carried 23,846 lbs. of mail. The Mars is the world's most economical airplane. Under optimum conditions, she can operate at less than 6 cents per ton-mile for a 1000 mile trip, which is the lowest direct flying cost for any transport today. Dependability is shown in her ability to make regular trips between Alameda and Honolulu every 2 or 3 days. This same quick turn-around demonstrates the Mars' ease of maintenance, especially since a good part of this time is spent loading and unloading. She's the world's largest flying boat, can climb on two engines and withstood, in test dives, a half-million pound pressure on her wings.

EQUALLY outstanding is the Martin PBM Mariner. Long range, heavy bombload and firepower, a remarkable record both as patrol bomber and transport . . . these are proof of high performance. Dependability is emphasized by rugged construction, ability to take off and land in high seas and capacity to take heavy over-loading in emergencies. Indeed, the PBM's dependability has been demonstrated by several successful landings on dry land with only minor damage to the planes involved. Ease of maintenance has been proven by the Mariner's pioneering of Pacific NATS routes when maintenance facilities at advanced bases were rudimentary.



Martin
AIRCRAFT
Builders of Dependable Aircraft Since 1909

FIRST plane to fly any ocean on a regular commercial schedule, Pan American's Martin-built China Clipper served across both oceans for more than ten years before meeting an untimely end when she struck a darkened boat in a blacked-out harbor. During her decade of service, the China Clipper flew the trans-Pacific route for 9 years, then shifted to the trans-Atlantic run. Her long years of service are added proof of the performance, ease of maintenance and absolute dependability of Martin aircraft. The Glenn L. Martin Company, Baltimore 3, Maryland.

The Anatomy and Physiology of the Airplane Cockpit

EUGENE F. DU BOIS*

Cornell University Medical College

Introduction

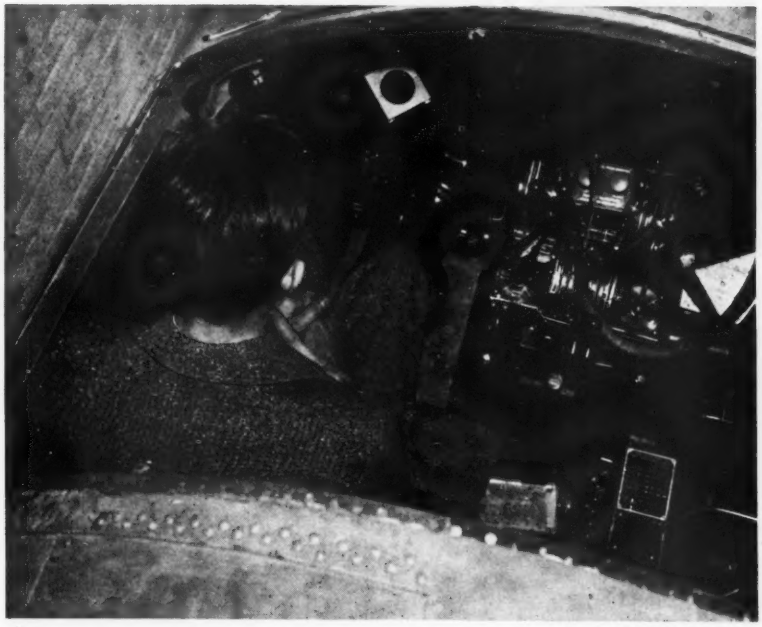
It may, at first, seem presumptuous for a physiologist to discuss a problem that appears to belong entirely to the field of engineering. On the other hand, it is strange that the engineers have gone ahead for decades without consulting anatomists, physiologists, and psychologists regarding problems that are largely physiologic and involve highly complex human behavior. It is true that when it came to the design of oxygen equipment they realized that experimental physiology was an essential part of the engineering problem. However, it has been only recently that some of the designers have appreciated the fact that the majority of cockpit problems are closely linked to the fields of physiology and psychology.

Development of Aviation Physiology

Perhaps this delay is the result of the tardy development of aviation physiology in our country. There had been a good deal of interest in the subject in the first World War, but during the years of peace we had little to show except the fine work of Armstrong and his associates.[1] With the outbreak of the second World War we discovered that the Germans had been working intensively on this subject ever since they first planned the war. When hostilities started in Europe the British and Canadians developed efficient systems of cooperation between civilian research bodies and the flying forces. As soon as it became apparent that the United States would be drawn into the conflict, the National Research Council formed a Committee on Aviation Medicine consisting of seven professors of physiology and medicine. Since 1942 projects sponsored by the Committee on Aviation Medicine have been financed by means of contracts recommended by the Committee on Medical Research between the Office of Scientific Research and Development and the institutions in which the work has been done. It has sponsored many studies in university laboratories. Every effort has been made to cooperate with the armed services and apply the principles of physiology to the practical needs of aviation. The particular project at Cornell University Medical College, under its Dean, Dr. Joseph C. Hinsey, has been concerned with crash injuries and their prevention.

At the same time, both the Army and Navy organized strong centers for research and development. The Civil Aeronautics Authority studies accidents in civilian planes. Great help was obtained from the Royal Air Force and Royal Canadian Air Force. Fortunately, the various governmental agencies cooperated so well that it is almost impossible to ascribe properly the credits for the different ideas presented in this report.

It is safe to say that our pilots' equipment is at last satisfactory. The time has come when we can take a broad view of the situation and look into the future.



In this cockpit installation the pilot might sustain serious head injury in a crash from the controls and bracket immediately in front of his head at the right and left.

The Need for Physiologic Design

Man developed aviation to its present extraordinary efficiency in the space of 40 years; it has taken Nature millions of years to develop the anatomy and physiology of birds. When man began to fly, it was necessary for him to extend himself toward a new physiology and almost a new anatomy. If we speak of a pilot's central nervous system and peripheral nervous system, we can also add a new external nervous system, consisting of the instruments and controls of the cockpit. These are fundamentally extensions of man's sensory and motor organs, developed to meet definite physiologic needs. To be fully safe and efficient—to be right—these instruments and controls should be developed from the combined points of view of engineers and physiologists.

During the rapid development of man's flight, engineers have attained surprising results by the methods of careful planning superimposed on a good deal of trial and error. I believe that it is fair to say that, although parts of the instrument panel and most of the important controls are well placed, other parts of the cockpit have been crammed, more or less helter-skelter with inadequate consideration of physiologic and psychologic needs.

Today the designers are developing planes whose operations are limited only by the limits of the human pilot. We

Paper read before the National Academy of Sciences, November 16, 1944.

* M.D., Department of Physiology and Biophysics, Cornell University Medical College, and National Research Council Committee on Aviation Medicine. Part of the work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Cornell University Medical College.

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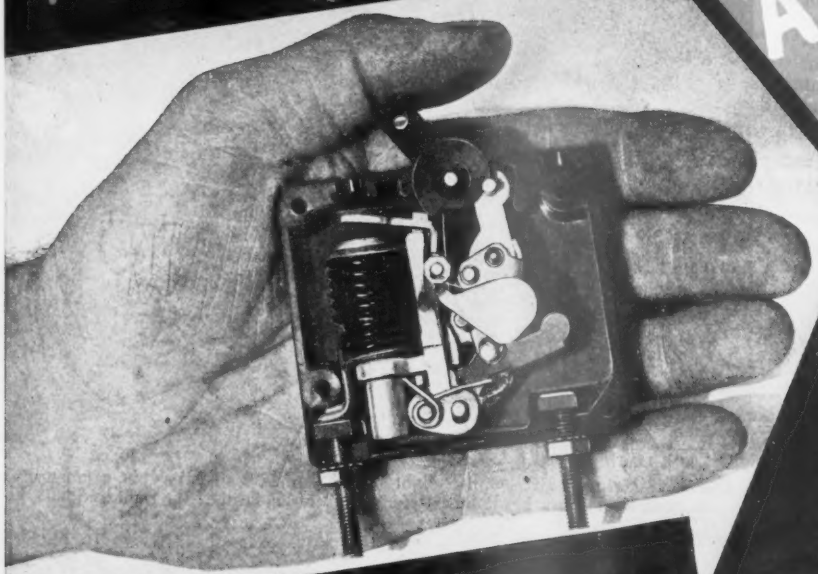

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Opens instantly on short circuits but delayed trip permits harmless overloads

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must have a reconsideration of cockpit design with reconstruction planned according to the principles of human anatomy, physiology, and psychology. At the same time, this will permit a much-needed standardization of the position and actions of instruments and controls.

Functional Extensions

All the changes in man's physiology introduced by flying are extensions of functions already experienced at ground level, but the extensions have been so enormous that the functions may be considered as new. For example, there are practically no occasions at ground level when a man's life depends on breathing pure oxygen through a mask that will not leak more than 5 per cent. There are no situations on the ground when a man, while exposed to a downward force five or six times the normal pull of gravity, must manipulate delicate controls. Under these conditions a man's arm and hand weigh 50–60 lbs.

It is certainly a new experience for man to maintain speed and equilibrium in three dimensions without the aid of vision, yet he must do this when flying in clouds or in the dark. In order to do this he has had to develop an elaborate new external nervous system of instruments. Using these efficiently, he can outstrip anything that flies.

Military Aviation Requirement

There are many other physiologic needs of great practical importance in aviation, particularly military aviation. For example, vision is paramount on take-off, combat, and landing, and the cockpit must be designed according to man's visual anatomy or he will have fatal blind spots. The Plexiglas and bulletproof windshield must be planned to give a minimum of reflection and distortion. The design of proper goggles is particularly difficult, and a frosting of goggles or windshield may be disastrous.

For night flying the pilot must be able to read instruments and maps and then, in a few seconds, search the surrounding darkness and discriminate between friendly planes and enemy planes. It is only by the most careful application of physiologic optics and well-developed routines that these two tasks can be combined.

Clothing

For many planes and many parts of the earth the clothing problem is not serious. However, in certain aircraft in tropical regions, the pilot may be exposed on the ground to a temperature over 100°F. and then in a few minutes to −40°F. In order to protect a gunner in a bomber at −40°F., it would be necessary to provide clothing so thick that it could not possibly be worn. Electrically heated suits are an answer, with many improvements yet to be made.

In addition to a suit that may be bulky in winter, the pilot must carry a parachute. If flying over water he must also wear an inflatable rubber life preserver and a rubber dinghy pack. Finally, when seated on the dinghy pack and parachute, he fastens himself securely with lap belt and shoulder harness. In case of an emergency he must try to bail out of a narrow hatch with all these encumbrances weighing perhaps 80 lbs.

Flight Emergencies

Serious emergencies occur in flight, particularly as the result of enemy action. It may be necessary to bail out rapidly, extremely rapidly if the altitude is below one thousand feet. In some planes escape is greatly facilitated by jettisoning the plastic canopies. In others this is not possible, and these planes could be made much safer by redesign. Escapes in spins or at very high speeds will always be dangerous until some radically new methods are developed.

Cockpit Comfortization

Seating

In fighter planes, the cockpit is of necessity small. The seat is narrow and cramped, and, although it may be raised or lowered a few inches, it cannot be tilted or moved forward. This means that a pilot is wedged in one position 5 or more hours, sitting on a dinghy pack containing rations, water cans, and a large carbon-dioxide flask. Pilots who have to cross the English Channel on long missions complain more about seats than any other feature of the plane. The complaints are verbal, since they hesitate to put in writing a discomfort that might appear trivial and perhaps undignified.

Apparently the science of seats is in its infancy, particularly when it pertains to seats in fighter planes. Some excellent work has been done with seats for school children and typists. We need intensive teamwork of anatomists and seat engineers in order to keep the aviator off his lumpy dinghy pack and provide some method of letting him shift his weight. A great deal of attention must be given to supporting the small of the back, a source of almost constant trouble. Pain and discomfort cause inefficiency.

Obstructions

The necessity of adding new and unexpected apparatus after a plane is originally designed has often crowded the pilot unmercifully. Surrounding his body there should be an inviolable space of minimal dimensions as determined by anatomic principles. These can be based on the large series of anthropometric measurements carried on by the Army Air Forces, and consideration must be given to short and tall pilots. Most important from the standpoint of safety in crashes is the avoidance of solid or sharp obstructions near the head. There is no excuse for the sharp angles and square corners and spiked toggle switches that are within range of the pilot's head as it is jerked forward or to one side in a crash. Where obstructions are absolutely necessary, angles can be rounded and padded. If spiked toggle switches must be used they can be recessed.

Control Installations

The anatomy of some cockpits is faulty in that a great many of the controls that are needed in the take-off, landing, and emergency are placed in awkward positions behind the pilot's elbows. They have to be located by touch, and, since they are not standardized as to position, a pilot when flying a new type of plane may easily pull the wrong control. If the landing gear control is placed near the flap control, the confusion may be serious. There is no good reason why controls of this kind cannot be placed so far apart that confusion would be impossible. Indeed, there are some planes where the landing wheels control is placed on the right side of the cockpit. For reasons of safety the pilot must retract his wheels as soon as possible after take-off. This means that he must shift his control stick to his left hand at a time when it is particularly important to have the best possible control.

Instruments

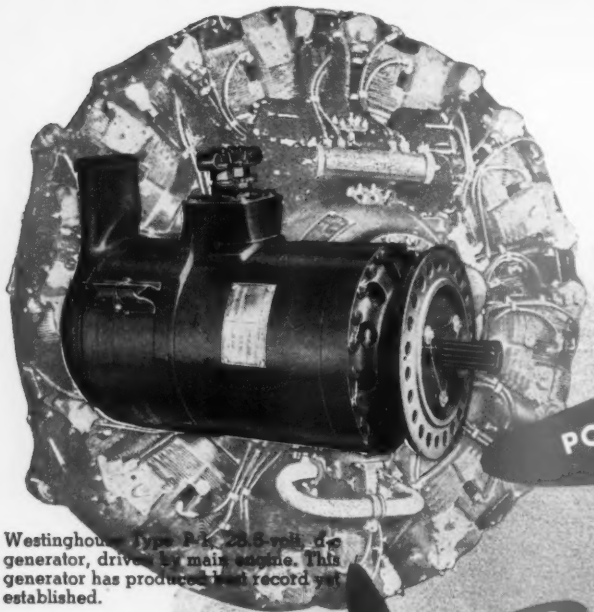
The important instrument dials are placed directly in front of the pilot's eyes and are easy to read. Some of the others have been set at such an angle that he cannot see them well without shifting his position. With further study they could all be placed at right angles to the line of vision and so designed and grouped that visual and mental fatigue would be greatly reduced.

There have been a few reversals of habitual directions of action that are worthy of study. Most boys are accustomed to the steering of sleds and bicycles. The rudder bars of the plane reverse this and the right foot must be pushed forward if you wish to turn to the right. Probably the old reflex is conquered rapidly, but it may gain dominance in an emergency.

Crash Survival

Planes are not supposed to crash, but experience has shown that a small percentage of them do. If the crash is at high speed or at a bad angle in rough territory, there is no chance of survival. Most crashes, however, are survivable. Hugh De Haven, in his study of falls from high buildings, has listed a number of escapes that seem miraculous.[2,3] He found evidence that the human body could stand enormously high decelerations if the resulting pressures were reasonably supported and distributed.

Just how many times G (one gravity) the body can stand with proper harness is not certain. In order to test this accurately, it would be necessary to drop men from increasing heights and the end point of this sort of titration would be



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Westinghouse Carbon Pile Regulator keeps voltage output of generator constant in spite of generator load and engine speed variations. Used with the Westinghouse Stabilizing Transformer, it provides a high degree of stability and accuracy.

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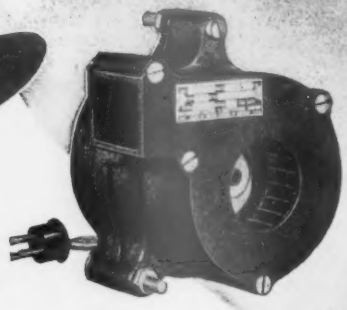
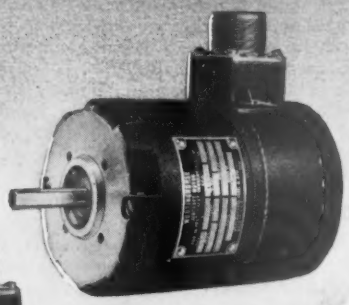
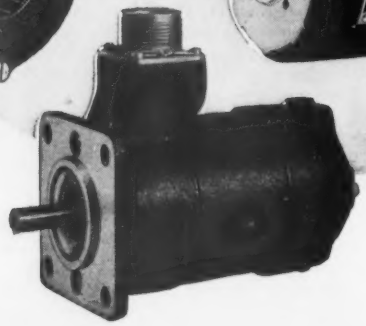
Westinghouse Differential Voltage Relay Switch closes when generator voltage reaches one-half volt above bus voltage.

MOTOR DRIVES







Westinghouse Motors are being built and supplied to perform a complete range of auxiliary functions in planes. All are designed to meet essential aviation requisites in motors: light weight plus ability to withstand extremes of temperature, altitude and humidity.

...FROM RPM...TO VOLTS...TO RPM

To do electrically the many things required to operate today's planes takes three different major types of electrical equipment. Each is a field of study in itself.

First, a means is needed for changing engine revolutions into electrical energy.

Then, control must be supplied . . . to compensate for changes in load and engine speed . . . to automatically connect or disconnect generators with the power system . . . to transform d-c power to higher or lower voltages for different jobs.

Finally, electrical energy must be converted back to rpm . . . to move wing flaps . . . to retract wheels . . . to rotate turrets.

There are few sources in the world with a firsthand background of experience in all three fields—especially as applied to aviation problems.

Westinghouse is one.

Westinghouse experience in building airplane generators began with the first ever built—wind-driven types to power World War I pioneer aircraft radio.

Dynamotors and control, likewise, date their development with Westinghouse from World War I.

Westinghouse aircraft motors date back to the first applications on the Shenandoah and the Akron. Additional applications have come as electrical systems were expanded, beyond the needs of lighting and radio communication.

This leadership continues—and will continue. Important present-day developments . . . high-altitude brushes . . . alternating-current power systems . . . are Westinghouse developments. Others are in progress. Together, they offer sound reasons for making Westinghouse your working partner in aviation progress. Westinghouse Electric & Manufacturing Company, Lima, Ohio.

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Electrical partner of the aviation industry

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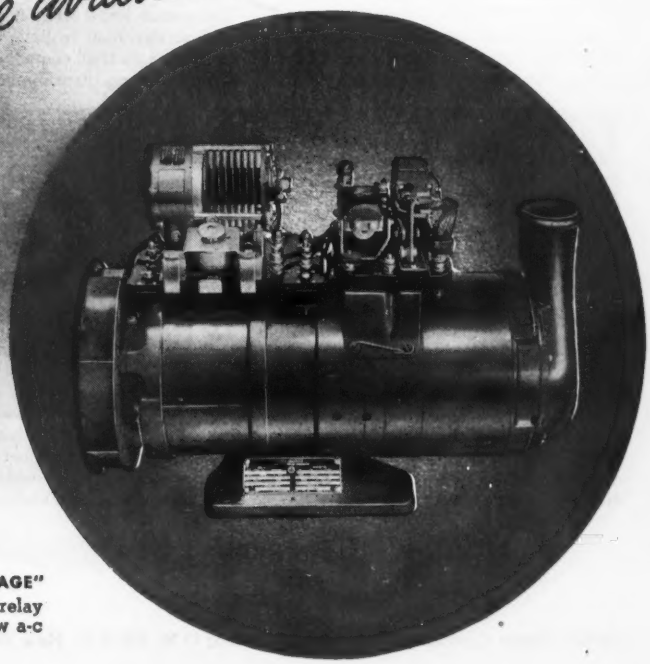
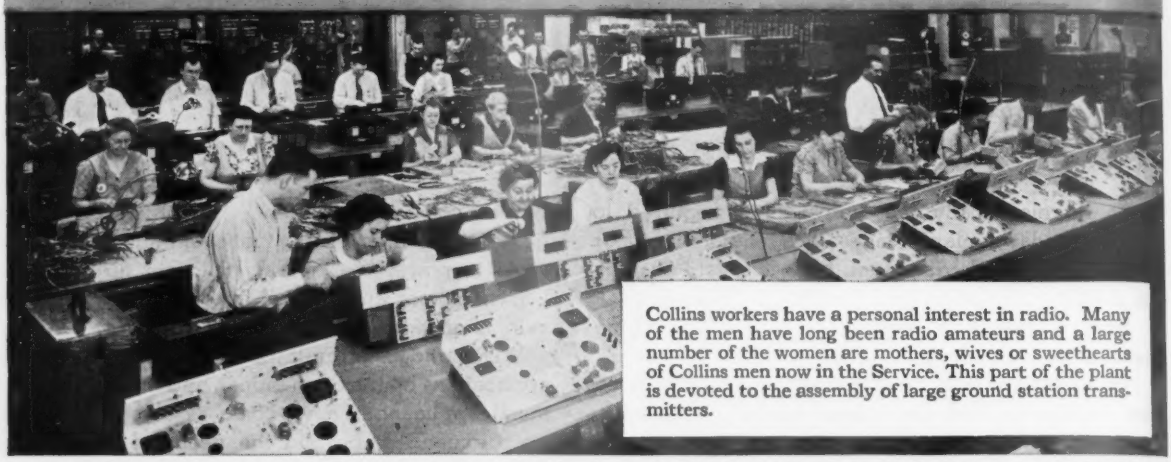


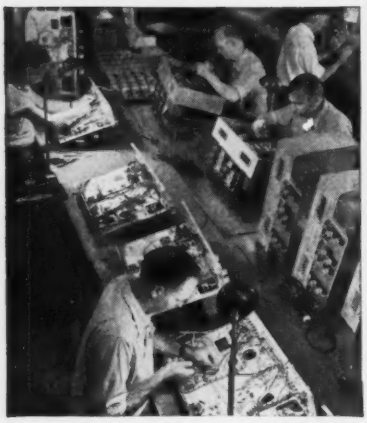
NEW A-C, D-C GENERATOR "PACKAGE"
Complete with voltage regulator and relay switch, designed to operate from new a-c systems in planes.

People who make Collins Radio

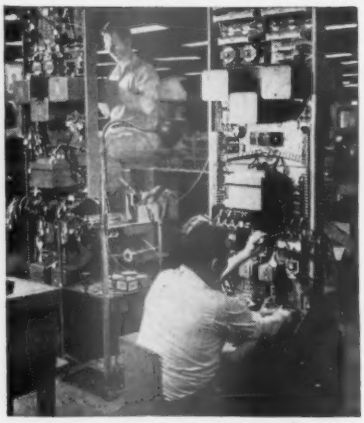
A few of the more than 3000 specialists who design and produce high quality radio communication equipment in the Collins plant.



Collins workers have a personal interest in radio. Many of the men have long been radio amateurs and a large number of the women are mothers, wives or sweethearts of Collins men now in the Service. This part of the plant is devoted to the assembly of large ground station transmitters.

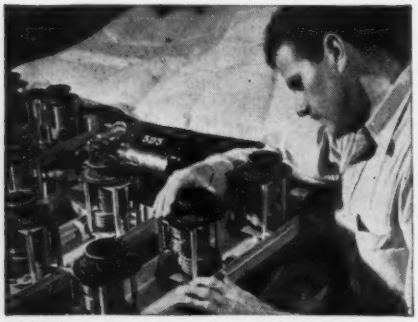


The technicians who wire the critical r.f. circuits in the exciter unit understand why each wire must be located and terminated with great care, exactly as engineered.



These men know what it means to the field service man to have cables neatly positioned so that component terminals are accessible and item numbers in full view.

Collins is a radio man's radio organization. Men of high technical integrity have come here from all parts of the country because Collins standards are their own ideals of excellence.



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the man's death. Such experimentation is unthinkable and tests on animals would be of little value. All we can do is to form rough estimates from calculating the decelerations of planes in which the pilots have survived when wearing good harness. It looks today as if the human body when properly held in harness would stand 30 G and probably 40 G without material injury.

Strengthening the Cockpit

It is not too much to ask that cockpits be stressed so that they will not collapse under forces that develop less than 30 G. At the same time, seats, their fastenings, and safety belts should be strengthened to withstand the same forces. In addition to strengthening the cockpit, great care should be taken in the placement of structural members, with the elimination of sharp corners and toggle switches that might be struck by the pilot's head. The careful studies of crashes now being made by the Civil Aeronautics Board, the Army, the Navy, and the Committee on Aviation Medicine of the N.R.C. indicate that a redesign of planes on these principles would save many lives. Here again is an application of the anatomy of the human. In most parts of our body we have considerable factors of safety which will stand stresses much greater than those ordinarily encountered. In a few parts of the body, such as the ankles, wrists, and forehead, the factors of safety are not large. These are the parts that must be especially guarded.

In our study of crashes it soon became evident that although it was important to protect in case of accident, it was infinitely more important to prevent the accident. The studies of the three Government agencies had shown that the overwhelming majority of accidents were ascribed to "pilot error." This term includes a large variety of subdivisions, but it is believed that a considerable amount of error is due to overloads of pilot function in emergency, to fatigue, and to faulty arrangement between the pilot and his cockpit.

Simplification and Standardization of Instruments and Controls

It would be most desirable if the number of instruments in modern, highly complex cockpits could be reduced. It is of the utmost importance that efforts be made toward a simplification and a standardization of position of as many instruments and controls as possible. Pilots are shifted from one type of plane to another as they advance in training or as they change their stations. They like to be able to fly many different aircraft. I know one instructor who has to fly 20 different types in training ferry pilots. Diversity of instrument position is not serious in ordinary flying, but the psychologists know a great deal about reversion to early habits in the stress of emergency. How much easier it would be for the instructor and his pupils if in each one of the 20 cockpits he could be certain that a given instrument or lever would be in the same relative position. When we consider them as part of our external nervous system, it is obviously as important for the engineer to standardize their positions as it is for Nature to standardize our central and peripheral nervous systems. What would happen if our ears were shifted to opposite sides of the head every time we got into a different automobile? Could we maintain binocular vision if on some days the eyes were placed three inches further apart? How would a pianist get along if there were twenty different sizes and arrangements of the piano keyboard.

A military design in which the seat harness might be ineffective in preventing head injuries during violent maneuvers or a crash because of the closeness of the windshield to the pilot's head.

De Haven, working on our Crash Injury Project, has expressed this well in a recent paper.[4] I shall quote at length:

"Cockpit hazards have built up rapidly as the speed, weight, and power of aircraft have increased. Each technical advance has increased the burden of pilot work by adding gadget to gadget, and piling instrument on instrument and control onto control, in cockpits already overcrowded, confused, and disorganized. To offset the dangers of over-complication, designers have had to use many signal lights and warning horns, which in themselves may increase the confusion when an emergency occurs. No complaint has come from pilots. They like it. They take just pride in being able to fly the toughest, most complex job, that can be handed them and they judge their ability by the difficulties and complications of their work.

"Wartime experience indicates strongly, however, that the rational limit of pilot function has been exceeded and that many accidents find their source in mental, physical and visual problems resulting from the profusion and bad schematic arrangement of controls. It is clear, for example, that during the take-off of a heavy ship, motor failure may require the decision to land straight ahead immediately. Under these circumstances the pilot must perform a certain amount of cockpit work in order to meet the emergency. He must shut off the fuel, turn off the ignition, switch off the battery, arm the fire extinguisher, and pull the pins in the safety hatch or cockpit enclosure. In addition to these needs, he has to judge his speed and work his flight controls to maneuver and land the ship. Under such conditions, the time necessary for the cockpit work may exceed the time allowed by the emergency itself, and the effort to do all these things hastily may lead to confusion and loss of control whereby the actual danger is aggravated to fatal proportions. Under extreme pressure he may act too quickly and reach for the right control in the wrong place due to close proximity of different controls, or to some habit fixation of previous learning."

Conclusions

In civilian planes safety in flight and landing are the most important considerations. In military planes they must become secondary to flight and combat efficiency. For long missions and combat every pound of weight counts. Maneuverability and gunnery are of prime importance. Any so-called safety factor that interfered with these would become an element of danger. Nevertheless, bearing in mind the military necessities, it would seem possible for the anatomists, the physiologists, and the psychologists to establish certain general principles of cockpit design. These principles can be coordinated with engineering principles and applied by aircraft designers.

Physiologists and engineers are at last working together in a project established by the U.S. Navy Bureau of Aeronautics. This study of the cockpit initiated by the Division of Military Requirements is under way in the Special Devices Branch. A representative of the Military Requirements Division of the Army Air Forces has collaborated in this work. A great deal is being done to standardize military cockpits and make them easier to fly, more comfortable, and much safer. All of these developments can be applied to the civilian planes.

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Decreasing Landing Time Losses in Air-Line Operations

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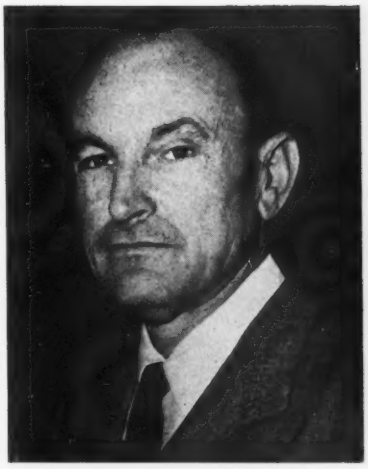


Introduction

THE PURPOSE of transportation is to move cargo from one place to another. The speed of transportation is the average speed for the whole movement of a cargo from its point of origin to its destination. In our present air transportation system there are frequent stops and a lot of time is spent on the ground at each airport. This is illustrated by the trip speeds of the air lines. The scheduled speed between New York and Los Angeles, for example, averaging the three carriers that compete for this traffic, is 118 m.p.h. These air lines use an aircraft that cruises at 180 m.p.h.

Allowance must be made in scheduling for winds and other incidental delays, but most of this loss of speed is caused by the time lost at landing stops. As a matter of fact, average actual speeds are still slower than scheduled speeds because flights often run late.

Overall air speeds of less than 100 m.p.h. do not have sufficient margin over possible ground speeds to win and hold a substantial volume of traffic. Streamlined trains and private cars on superhighways are already fast enough to compete at these speeds and undoubtedly will be faster in the future.

Speeding Ground Handling

Speed is not the only thing the air lines have to sell. It has been demonstrated that they can offer convenience, comfort, exhilaration, and a service that is flexible, stimulating, and pleasant. But speed is still the greatest asset of flying, and it is the overall speed that counts.

Air-line schedules can be stepped up by using faster airplanes and by decreasing the time lost at landing stops. It can be expected that the cruising speed of aircraft will increase somewhat after the war, but beyond a certain economical speed each extra mile per hour becomes costly. The speeding up of schedules by decreasing the time lost at each landing stop is much more promising in economy and in increased service to the public.

At the present time, we are on the threshold of a vast expansion of air transport to extend service to a much larger number of smaller cities and towns. Except for express or transcontinental schedules, this will increase the number of stops per schedule. Consequently, the problems of maintaining scheduled speeds will be more difficult in the years after the war.

There are a large number of little causes of delay at landing stops and some that are important. Each of these causes will have to be analyzed. Even though an average of only a few seconds may be saved, the total time saved will become worth while when it is remembered that the saving is repeated over and over again at thousands of landing stops each day. Some of the gains will come from changes made in the aircraft itself; some from the layout of the airport; some from the design of special equipment to facilitate loading, servicing, etc.; and some from operating procedures that will permit faster operation.

Loading and Unloading

With respect to loading and unloading, the air lines are at present operating an aircraft that is not so convenient for passengers and is particularly bad for mail and other cargo. The doors of the DC-3 are some distance from the ground, requiring loading platforms. Moreover, cargo space is cut up into a number of small and somewhat inaccessible compartments. Obviously, the aircraft can be made much more satisfactory from the standpoint of rapid loading, and the place to start is in the basic layout of the design. Placing the fuselage horizontal and close to the ground by the use of a tricycle landing gear is a good beginning. If the wing is put above the fuselage, ample access to all parts of the fuselage can be had through such doors as may be required to load and unload quickly each cargo or passenger compartment.

If passenger doors actuate a small folding step attached to the airplane, passengers could easily climb in or out without the necessity of pushing a loading platform into place.

By using a stop watch on a considerable number of trunk air-line landings, it was found that the average between the time the wheels touched the ground in landing and the time they left the ground in take-off was around 20 min. Except for refueling stops it should be possible to cut this down to 5 min. A refueling stop should take not more than 8 min. On smaller airports with a single landing strip, this loss of time should be even less.

Refueling

At stations where refueling is necessary, there seems to be room for speeding up the refueling process. The present procedure is to carry out ladders for several men to climb on top of the wings, while a large gasoline truck-trailer backs into place. Though only a few hundred gallons are taken aboard, several thousand gallons are brought out to the aircraft and then taken back again. The method of finding out how much gasoline there is in an airplane tank is to measure it with a stick, and you know the tank is full when it runs over.

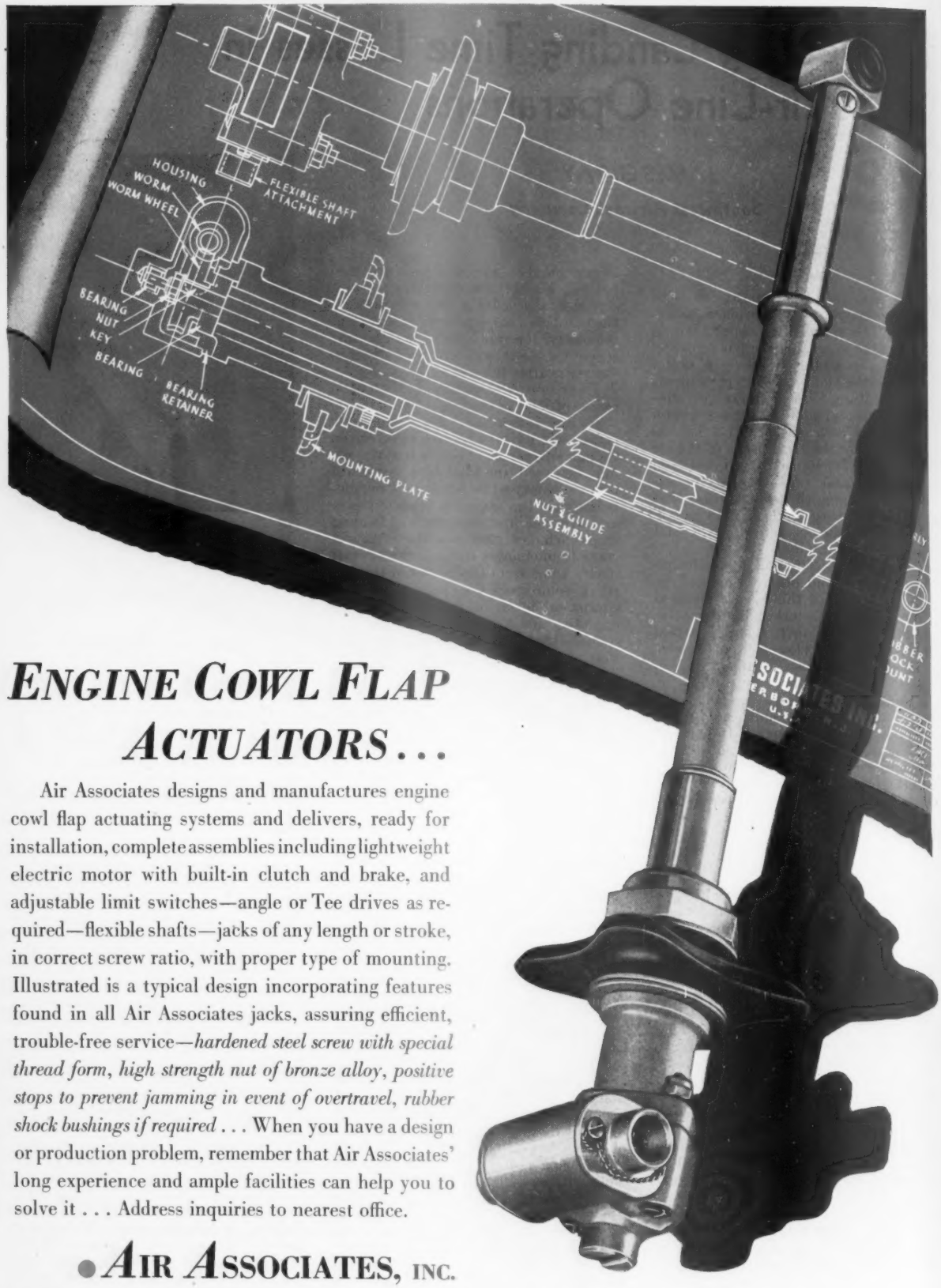
It seems logical that a smaller container holding about the amount of gasoline that needs to be serviced into the airplane, mounted on a vehicle similar to a jeep, could be handled much faster. The high-wing arrangement would allow free movement of the special servicing vehicle under it. The filler cap could be located under the wing in a position where it could be conveniently reached. The same considerations apply to oil.

Engine Problems

Another procedure that loses considerable time is the starting of engines. It is not unusual to see an engine turn over for quite a number of seconds before it finally starts. At refueling stops it still may be necessary to stop the engines because of fire hazards, etc., but a method should be devised to keep them running at all other stops. This is not difficult in the case of the engine on the opposite side of the fuselage from the passenger loading door, but it seems necessary that the propeller on the passenger door side be stopped while passengers are loading and unloading.

Presented at the National Air Transport Meeting, I.A.S., Washington, D.C., October 20, 1944.

* Vice-President.



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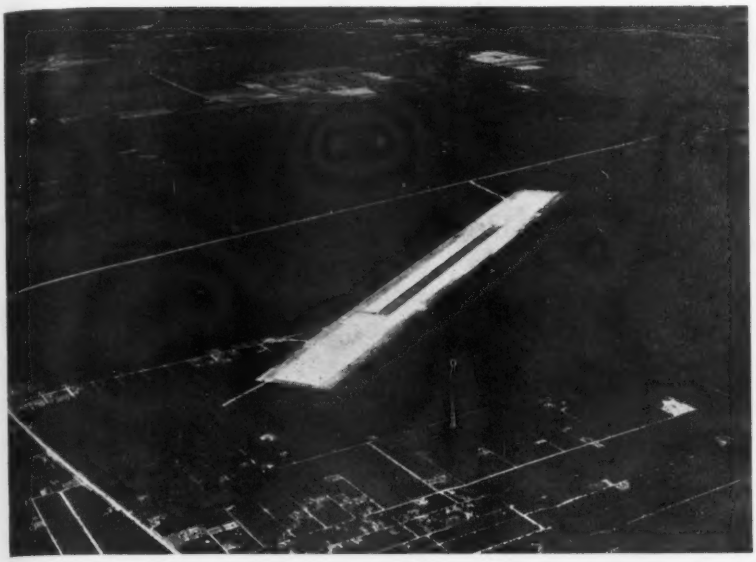

Official Photograph U.S. Army Air Forces

A directional flight strip, as little as 2,500 ft. long and 300 ft. wide, will enable feeder air lines to establish timesaving operational procedures. Take-offs and landings can be made "on-course" from this type of facility, and aircraft with tricycle undercarriage largely eliminate hazard of cross-wind landings.

It may be that the engine manufacturers can help this problem by providing a means for disconnecting the propeller from the engine at idling speeds. This means was provided on a Roadable Autogiro delivered to the Department of Commerce in 1935, and its incorporation in geared engines should not prove too difficult. A small propeller brake would be needed, as well as a small clutch or synchromesh to bring the propeller up to the idling speed of the engine when the gears are to be reengaged.

If the aircraft could be taxied with only one propeller running, time could be saved in getting to the loading ramp and away from it again. The propeller on the loading side could be stopped while taxiing in and then started again while taxiing out for the take-off. It is believed that a properly designed tricycle landing gear with a steerable nose wheel can give this taxiing characteristic even with engines in their conventional location on the wings.

Other engine arrangements would further improve the situation—notably, a pusher arrangement where the propeller is walled in by the tail booms. However, such arrangements have some disadvantages. The conventional arrangement with a special landing gear is probably the most promising. Being able to taxi on one engine is important and definitely worth making some sacrifice for.

By taking advantage of such timesaving devices, as much as 4 or 5 min. could be saved in the loading and unloading of the aircraft. Where landings are made as frequently as every 100 miles, schedules would be speeded up 10 to 12 m.p.h. by these savings alone.

Flight and Taxiing Procedures

There are other savings that are still more important, particularly those to be derived from changes in flight and taxiing procedures. The basic design of the aircraft must be considered when dealing with loading and unloading problems.

The flight and taxiing procedures depend on the handling characteristics of the aircraft and the layout of the airport.

On-Course Landings

One of the biggest gains to be expected is from the freedom the tricycle landing gear will give in direction of landing. When it is no longer necessary to land into the wind, a greater number of landings can be made on-course, thus saving the time spent in traffic circles.

Much of our present procedure for airport approach is built on the idea of the traffic circle. Local field rules are often excessive in the amount of circling time required. For example, on a recent flight we approached the Albuquerque airport from the northeast when traffic was landing toward the south. Field rules required that we make a complete circle before landing—a circle that took 5 min. and, at 150 m.p.h., represented $12^1/_2$ miles. At 30 cents a mile—a conservative estimate of the actual flight costs—this was $3.75. If repeated for the thousands of landings made each day, this is a considerable item of expense, as well as a great loss of time.

The maximum saving in time would occur in an on-course operation where both the landings and the take-offs were made on-course without any circling whatever. Such an operation can be had from a landing strip laid out parallel to the air route. Much of this saving can also be retained in operating from the less congested airports at the smaller towns.

Even on busy airports a substantial proportion of take-offs and landings can be made on-course if traffic is closely controlled and the collision hazard eliminated. A primary objective of all airport traffic control should be to permit as much on-course operation as possible.

(*Continued on page 39*)

The design of Lockheed's proposed "Saturn" illustrates several points: (1) The high wing permits easier access to all parts of the fuselage through cargo and passenger doors. (2) The low, horizontal fuselage obtained from the use of tricycle landing gear eliminates need for bulky passenger loading steps and platforms. Timesavings from such items can amount to as much as 5 min. per landing.

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Potentialities of a Capacitance Measurement Method for Fuel Quantity Gages in Aircraft

C. F. SAVAGE* and D. B. PEARSON†

General Electric Company

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SYNOPSIS

Methods employing capacitors make available several possibilities in the field of fuel-quantity measurement, particularly in aircraft applications, that are not usually present in the conventional float type of remote-indicating liquid level indicators. A method using electric condensers in the fuel tank is described and the potentialities of such a system are discussed.

INTRODUCTION

CONVENTIONAL methods of measuring the fuel quantities in airplane gasoline tanks include sight gages; float lever gages, either direct-reading or remote-indicating; and gages operating on the hydrostatic principle. All of the above have certain features that have made them applicable to various types of aircraft with good results.

Rapid development of aircraft has created new conditions that accelerated the study of other methods of fuel-quantity measurement. A fuel-quantity gage operating on the principle of change in electric capacity with a change in liquid level has proved to be practical. Other means may be feasible, but the capacitor-type gage offers many interesting potentialities.

Longer flights in larger airplanes have necessitated increased gasoline loads. Flight economy dictates accurate fuel-quantity indication regardless of airplane attitude. By proper design, the attitude errors may be reduced to a minimum by the use of capacitor-type gages. Totalizing of the fuel content of multiple tanks, as required by airplane design and safety requirements of fighter planes, is a function that is readily performed.

Variations in design of capacitor-type gages suggest that problems in connection with installation of this accessory in relatively inaccessible locations can be reduced.

Presented at the National Fall Meeting, I.A.S., Dayton, Ohio, November 9–10, 1944.

*,† Engineers, Aeronautical Instrument Engineering Division.

CAPACITOR-TYPE GAGES

Principle

Operation of the capacitor-type gasoline gage is dependent upon the difference in dielectric constants of air and gasoline. Most gasolines have a dielectric constant of approximately two, compared to one for air. The condenser plates are installed so as to reach from the top to the bottom of the fuel tank. As the gasoline is consumed it is replaced by air; the resultant impedance change controls a vacuum tube circuit

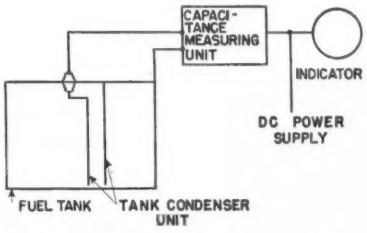

FIG. 1. Schematic wiring diagram of capacitor-type gasoline gage.

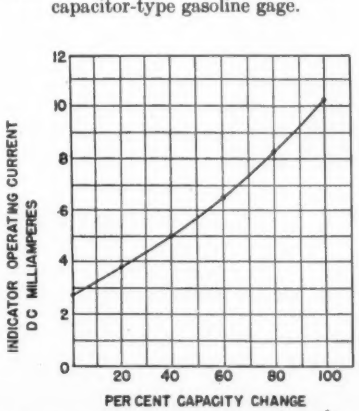

FIG. 2. D.C. output current vs. per cent change in capacity of tank condenser.

D. B. Pearson.

which converts the capacity changes into variations in d.c. output current. This current may be utilized to operate an indicator at a remote location. A schematic diagram of a typical capacitor-type installation is shown in Fig. 1. Fig. 2 shows how the operating current varies as the capacity of the tank condenser is changed. It is evident that the output current is of sufficient magnitude to operate satisfactorily a milliammeter type of indicator.

Effect of Different Gasolines

It is shown above that the indication of fuel quantity obtained is a direct function of the dielectric constant of the fuel. Tests show that various types of gasolines have different dielectric constants. Fig. 3, Curve A, illustrates how this factor varies as a function of the density of the fuel. Curve B of Fig. 3 shows the relationship of the ratio of dielectric constant and density to the density of the fuel. A study of Fig. 3 reveals that the capacitor-type gage measured mass of fuel rather than volume. This is true as long as Curve B of Fig. 3 remains a horizontal line, indicating that the density and dielectric constant of the fuels are varying at the same rate. The amount this curve deviates from a horizontal line is a measure of the error in indication produced by varying the type of gasoline when the fuel quantity is considered on a mass basis. Curve A of Fig. 3 indicates a large error in indication when considered on a level basis, since the volume of fuel varies inversely with its density.

It is evident that the capacitor-type fuel gage should be calibrated in terms

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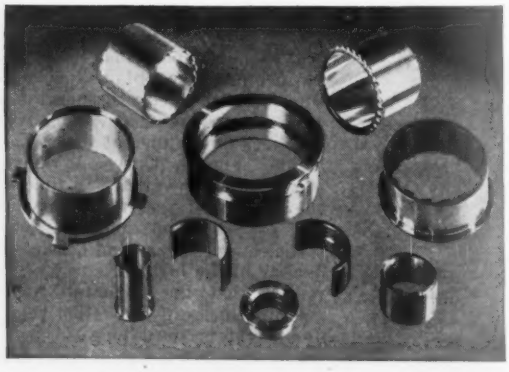

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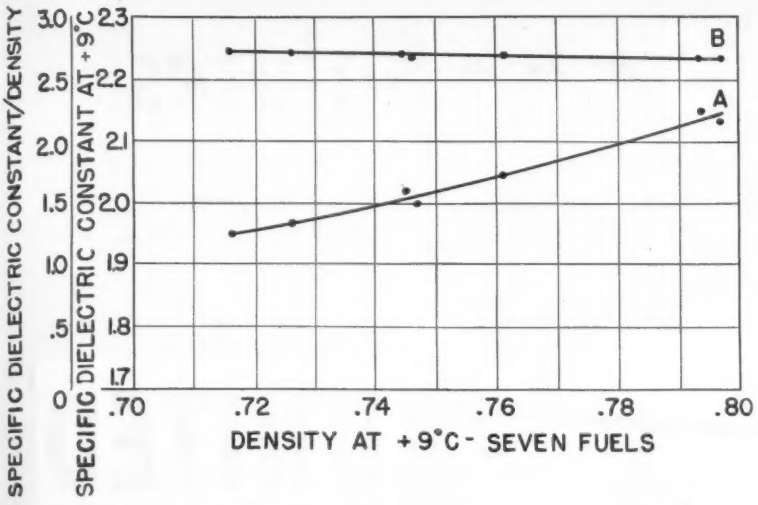

FIG. 3. A. Dielectric constant vs. density for various gasolines. B. Ratio of dielectric constant and density vs. density for various gasolines.

of pounds of gasoline instead of in gallons. This is necessary because several types of fuel may be used in the same airplane, and it is not desirable to recalibrate the gage each time the type of fuel is varied. In general, fuel of the same octane rating will always be used in a particular airplane. The variations considered here are within a single octane rating.

When considering fuel quantity from the point of view of actual flying time remaining, the pound is a much more stable unit to use than the gallon. The power available per pound of fuel is much more constant than the power per gallon of fuel. At the present time, the practice of calibrating fuel-quantity gages in gallons is almost universal. On this basis, the capacitor-type gage exhibits a large error when fuels of different densities are used.

Temperature Error

The fuel in an airplane may be subjected to a wide range of temperature variations. For this reason it is necessary to know the effects of these temperature changes on fuel-quantity indicators. This discussion will not include the effects of temperature variations on the fuel-measuring equipment but simply the changes produced in the fuel itself.

Fig. 4 shows the changes in the indicated volume obtained with a float-type gage as the temperature of the fuel is varied from +70° to −50°C., based on volume at +25°C. Fig. 5 shows the same data for a capacitor-type gage. The error shown in Fig. 4 is due to the relatively large temperature coefficient of density of the gasoline, which is found to be 0.112 per cent per degree C. The volume of the fuel varies inversely with the density, and the float arm follows the changes in level of the gasoline. It was stated previously that the indication produced by the capacitor-type gage will be correct, on a mass basis, as long as the ratio of dielectric constant to density remains constant. This is also

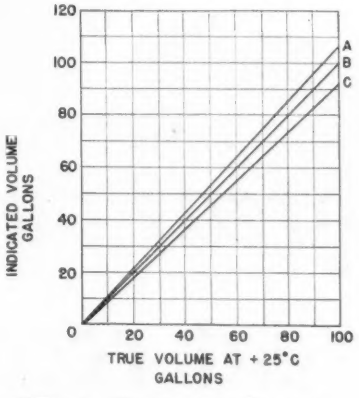

FIG. 4. Float-type gasoline gage. A. +70°C. B. +25°C. C. −50°C.

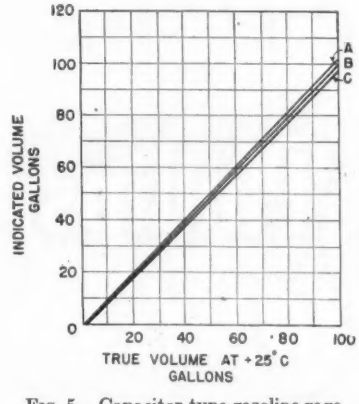

FIG. 5. Capacitor-type gasoline gage. A. +70°C. B. +25°C. C. −50°C.

true when the temperature of the fuel is varied. The error shown in Fig. 5 is due to this ratio changing slightly as the temperature changes. The temperature coefficient of this ratio is found to be 0.019 per cent per degree C., about one-sixth of the temperature coefficient of the density.

This shows that, when the temperature error is considered on a basis of true volume at a fixed temperature, or on a mass basis, the effect of temperature changes on the fuel produces much less error with the capacitor-type gage than with the float-type gage. When the temperature error is based on actual volume at each temperature being considered, the float-type gage has zero error, while the capacitor-type gage has errors equivalent to the errors of the float gage on the mass basis.

Effect of Airplane Attitude

It is realized that with a single tank unit, either float-lever or tubular-capacitor type, it is not possible to obtain accurate indications of fuel level for more than one position of the fuel tank. This is particularly true with the irregularly shaped tanks often found in modern aircraft. During normal operation an airplane often flies at different angles of pitch because of varying loads. Abnormal conditions, such as the loss of one or two engines in multiengined aircraft, force the plane to be flown at a large angle of bank in order to maintain the desired course. It is considered important to provide a fuel-gage installation that will indicate accurately the fuel remaining in the tank over a 20° range of pitch angle. It is also desirable to reduce the error due to bank, but, since errors due to pitch are encountered more frequently, emphasis is placed on reducing these.

Fig. 6a shows a float-type gage indicating correctly the fuel quantity in a tank. Fig. 6b shows the error produced

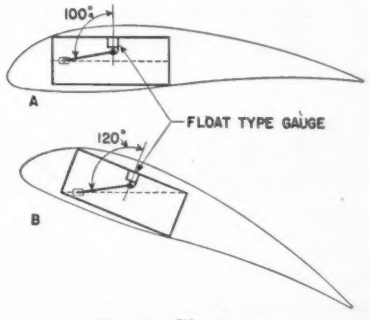

FIG. 6. Float type.

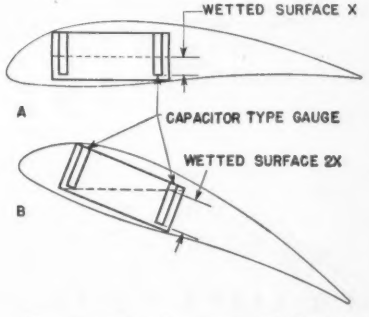

FIG. 7. Capacitor type. Installation of gasoline gages showing effect of airplane attitude change. A. Normal flight position. B. 20° climb.

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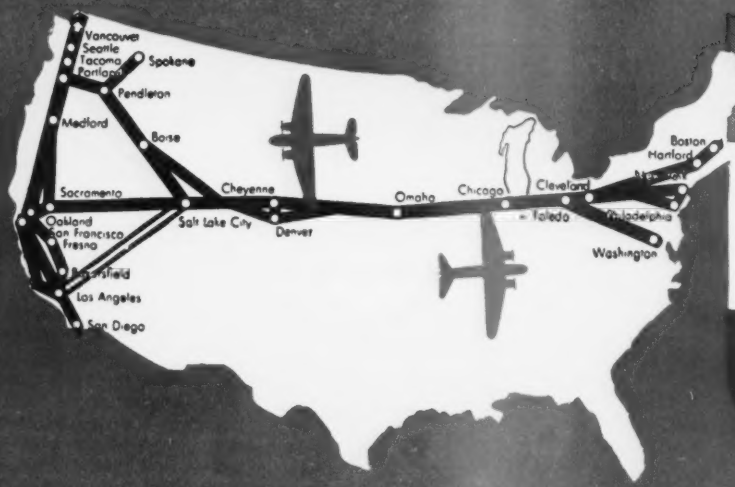

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TABLE 1

Tank Capacity = 78 Gal. Actual Gallons in Tank During Test = 15.6*

Airplane Attitude Angle	Single Gage		Multiple Gage	
	Indication in Gal.*	Error—% of Full Tank	Indication in Gal.*	Error—% of Full Tank
20° climb	12.2	−4.36	15.5	−0.13
15° climb	14.2	−1.79	15.0	−0.77
10° climb	15.5	−0.13	15.4	−0.26
5° climb	16.0	+0.51	15.9	+0.38
0°	15.6	0	15.6	0
5° dive	14.6	−1.28	15.9	+0.38
10° dive	14.2	−1.79	15.9	+0.38
15° dive	12.7	−3.72	15.1	−0.64
20° dive	9.7	−7.56	16.6	+1.28

* Readings refer to full-size tank.

when the tank is tilted 20°. It is evident that any method that measures the fuel at only one point will be in error under these conditions. The best single position would be at the center of the tank and even this would produce errors at low fuel levels where accurate indication is most important. Fig. 7a shows the same fuel tank with a dual-capacitor-type installation. Fig. 7b shows this tank again tilted at an angle of 20°, but the indication is the same as in Fig. 7a, since the same amount of condenser area is wetted in both cases. It would be possible to install a float-type gage in each end of the tank, similar to the capacitor installation, and obtain accurate indication in this manner. The problems encountered in totalizing the indication of the two float-type units become involved, in contrast to the simplicity of totalization with the capacitor-type unit. This feature of the capacitor gage will be discussed more fully later.

If the fuel tank is of irregular shape, it may be necessary to install more than two transmitter units. This is feasible, although a large number of units complicates the installation of the gage and adds to the weight of the airplane. Three condensers should adequately reduce the attitude errors produced by conditions encountered in natural flight.

Table 1 shows data taken on the model tank illustrated in Fig. 8. This small tank is a reproduction, on a one-third scale, of a wing tank of an airplane. An examination of these data, plotted as Fig. 8a, shows how the errors produced by airplane attitude changes are reduced by the addition of two supplementary tank condensers, one at each end of the tank. Such an installation is illustrated by the rectangular tank shown in Fig. 7. The capacitor unit shown in the center of the tank in Fig. 8 is necessary to measure the fuel in the lowest part of the tank, since it has a recessed section not reached by the capacitor units installed at the ends.

It is possible to reduce errors produced by airplane attitude by installing parallel condenser plates in the fuel tank rather than condenser tubes. These plates would have to be incorporated into the tank when it is being fabricated and would form a part of the baffle system of the tank. Up to the present time less emphasis has been placed on the use of parallel plates because the use of concentric tubes has appeared to be more practical.

Totalization of Indication

The capacitor-type gasoline gage lends itself readily to totalization of transmitter measurements. Fig. 9 shows how this is accomplished. The individual condensers are connected together and to the capacitance measuring unit by a low-capacity shielded conductor such as coaxial cable. It is important that this type of conductor be used in order to reduce its effect in the circuit to a minimum. The addition of the capacitances of the various tank units in this manner provides a simple and effective means of totalizing the measurements.

The design and function of modern aircraft sometimes necessitates the totalization of the fuel in several tanks of the airplane. The method described above can be extended to apply to several tanks, provided the tanks are located in close proximity to each other. If the tanks to be totalized are too far apart, the amount of coaxial cable necessary to interconnect the tank condensers will have sufficient electric capacity to materially impair the operation of the gage.

If it is desired to totalize the fuel in tanks located too far apart for the method described above, it is possible to use two or more capacitance measuring units and totalize the output currents of the units by the indicator. When this method is employed, it is possible to

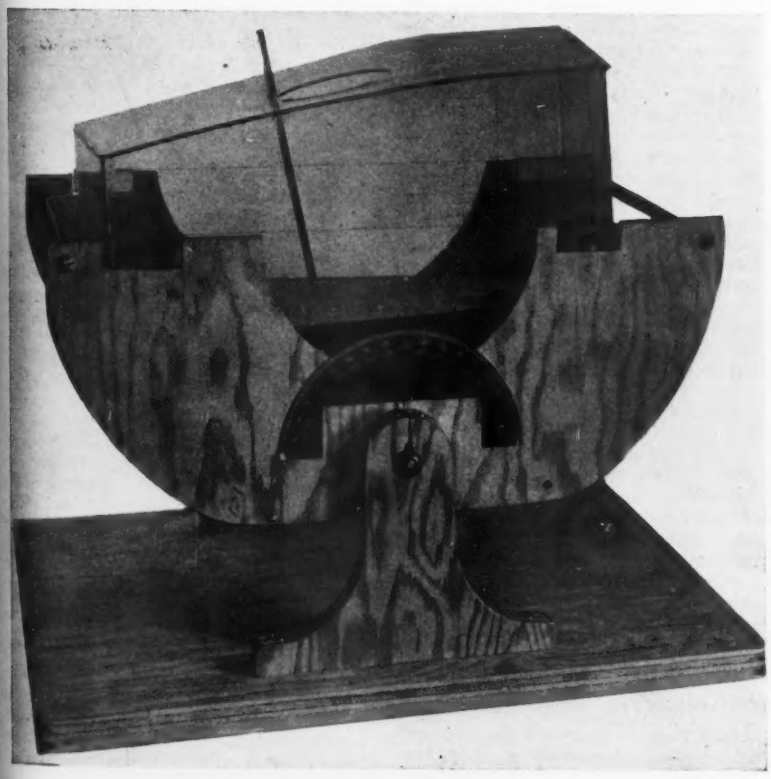

FIG. 8. Model airplane tank shown in test cradle.

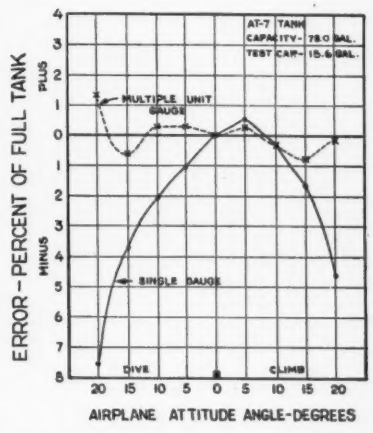

FIG. 8a. Correction of attitude errors by use of multiple unit tank units.

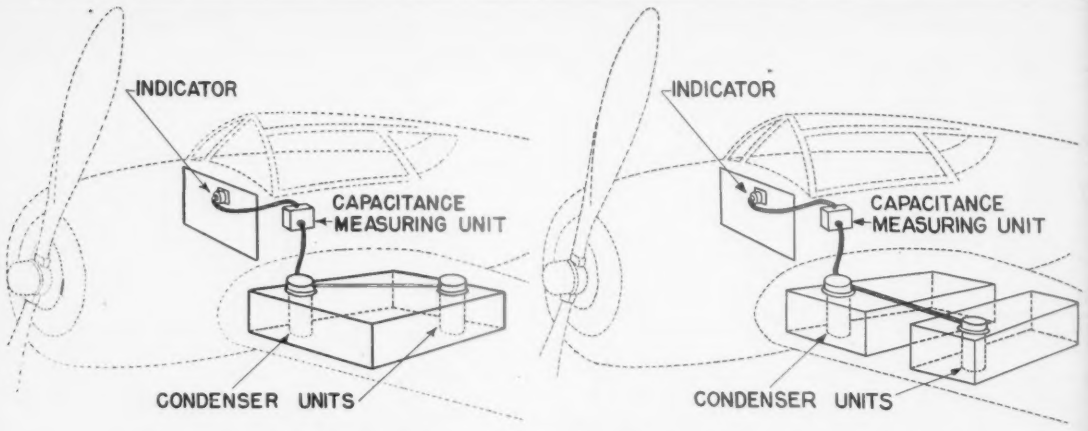

FIG. 9 (*left*). Sketch of capacitor-type gasoline gage installation showing totalization features.
FIG. 9a (*right*). Capacitor-type gasoline gage installation showing totalization of multiple tanks.

obtain separate indication of the fuel quantities measured by each unit, as well as a totalized indication of the fuel remaining in all of the tanks. An installation of this kind is illustrated in Fig. 9a.

Remote Location of Capacitance-Measuring Unit

The capacitance-measuring unit may be located remotely from the tank condenser unit. This feature may be utilized in installations where sufficient space is not available to accommodate the measuring unit at the point where the tank unit is installed. An example of this would be a tank that is formed by the wing skin itself, where it is not desirable to cut the stressed section of the wing to provide space for the capacitance measuring unit. The measuring unit could be installed in some convenient location within an 8- or 10-ft. radius of the tank unit and connected to it by means of a section of coaxial cable. The measuring unit may also be remotely located when it is desired to make the unit more accessible for adjustment and maintenance. The increased accessibility should prove to be of importance when applied to military aircraft which must be serviced and repaired under adverse conditions and with a minimum of facilities.

Indicator Pointer Oscillation Produced by Sudden Attitude Changes

A difficulty that is present in the float-type gage is the large amount of indicator pointer oscillation produced by sudden and continuous changes in attitude of the airplane. This objection applies mainly to military aircraft, when the direction of flight of the airplane is changed rapidly, as in an attempt to avoid the antiaircraft fire of the enemy. The sudden changes in position of the fuel cause the float arms to move. These produce objectionable oscillations of the indicator pointer.

This difficulty is overcome, at least to a large degree, by the capacitor-type gage. The orifices through which the fuel has access to the space between the condenser tubes or plates may be made small enough to damp out these oscillations of the fuel. This eliminates the trouble at its source and produces much steadier indicator operation. The orifices through which the fuel flows should not be made too small, for dirt and other foreign matter in the tank might clog them and impair the operation of the gage.

Calibration

Calibration of the capacitor-type instrument after installation in the fuel tank may prove to be more difficult than with the conventional float-type gage. The zero point for either instrument is equally easy to adjust, since empty and full-scale adjustments are provided. With the float type, the float arm may be lifted manually until it touches the top of the tank. This provides an opportunity to adjust the full point almost as easily as the empty point. The capacitor-type gage has no float arm, so the tank must be filled with fuel to adjust the full-scale point. It may seem unnecessary to calibrate the gage after installation in the airplane, if accurately adjusted in the factory. The fuel tanks vary an appreciable amount, making it necessary to calibrate the end scale points after the gage has been installed in the tank.

It is desirable to have end scale adjustments that will cover all expected variations between tanks and to have the adjustments independent of each other. Up to the present time, adjustments with ranges comparable to those of the float-type gage have not been found applicable to the capacitor-type instrument. Nor are they so independent of each other as would be desirable, but it is considered likely that additional development work will result in more satisfactory calibrating methods.

Installation Limitations

It is possible to mount the vacuum-tube measuring unit of the capacitor-type gage remotely from the tank unit. A variety of condenser systems may be used, but one or more pairs of concentric cylinders, or tubes, appear to be the most practical. It is possible to install vertical plates in the tank to serve as the condenser part of the measuring unit. In tanks that are fitted with baffles it may be feasible to utilize these as the grounded plate of the condenser. If the tank is of an irregular shape and a linear indicator scale is desired, it may be possible to obtain such a scale by placing holes in the condenser plates. This will make the capacitance change nonuniform to compensate for the nonlinearity of the tank. If desired, a combination of plates and tubes may be used as long as the condenser surfaces extend from the top to the bottom of the tank.

Many fuel tanks have the mounting location for the fuel gage at the end or side of the tank, since this is often the most accessible part. This involves no difficulty for the float-type gage, which can be designed to operate as well from a horizontal position as from the vertical. It is rather difficult to provide a capacitor-type installation to fit this case because the condenser unit must extend from the top to the bottom of the tank. It appears necessary for tanks that are accessible only from the side or end to have the capacitor built into the tank when it is fabricated.

Mechanical Stability

Fuel-quantity gages, as well as all other component parts of an airplane, must be made sufficiently rugged to withstand the vibration and acceleration stresses received in service. The capacitor-type gage lends itself readily to a rigid construction that should stand up well in service. The lack of contact surfaces and moving parts is advantageous. One of the tubes or plates of the tank condenser is at ground potential, and may be supported at both ends, and also at intermediate points if necessary. The long arm necessary with the float type of gage, when used in large tanks, introduces serious difficulties from a mechanical standpoint.

(*Continued on page 37*)

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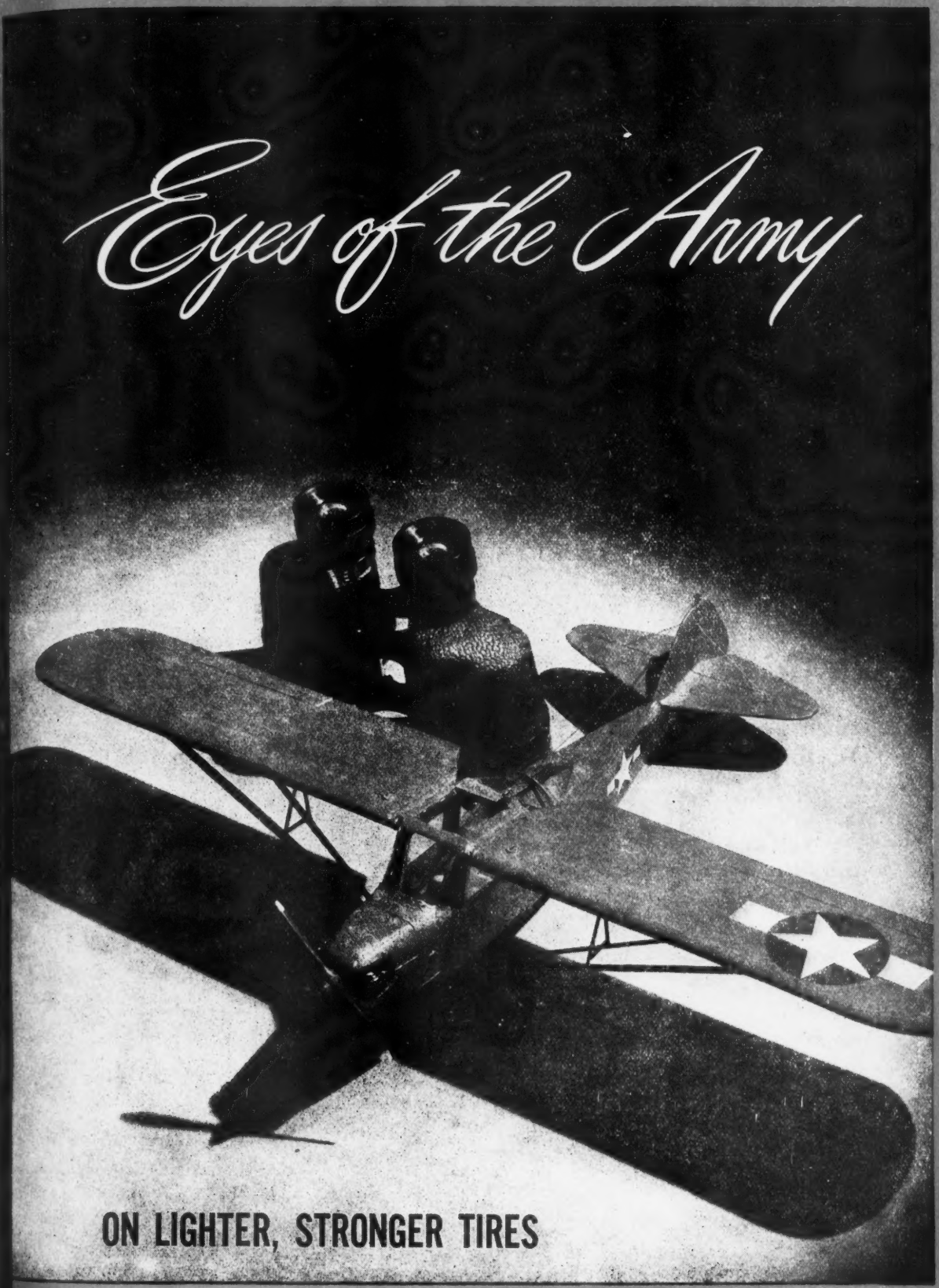

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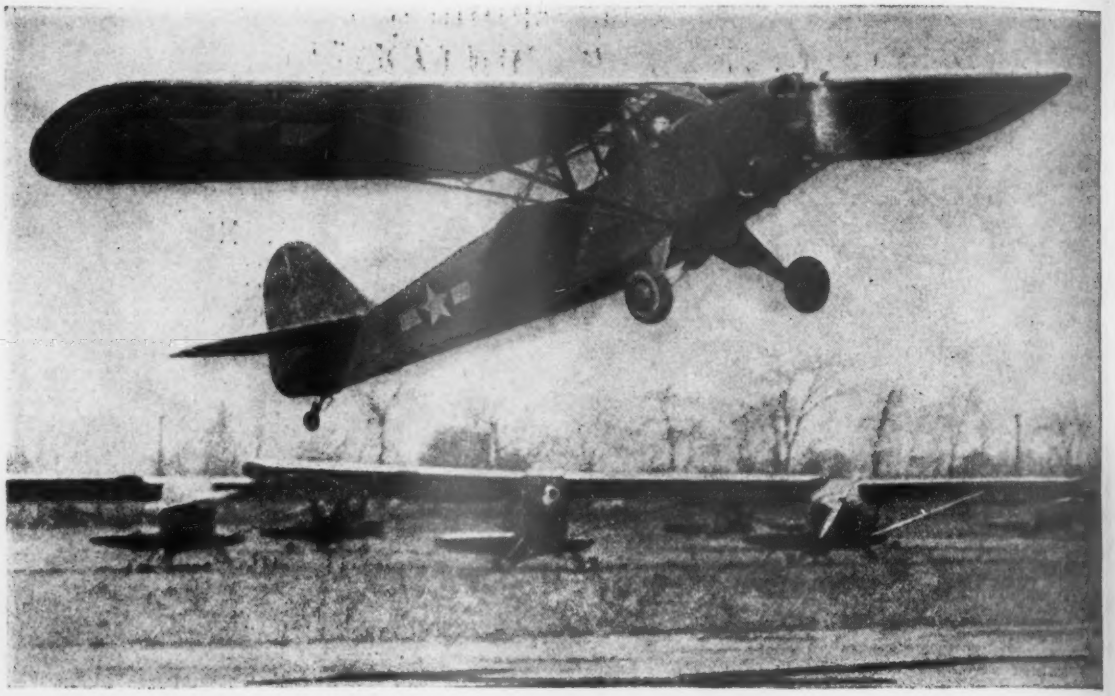

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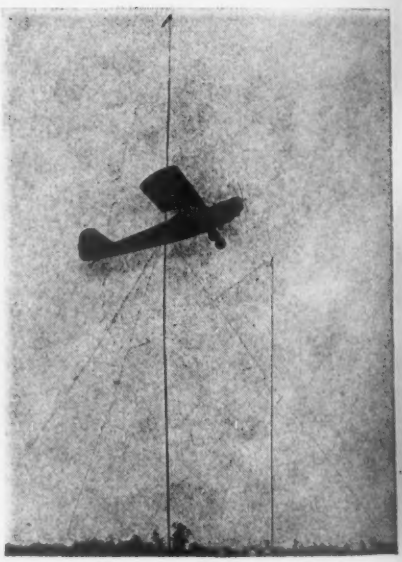

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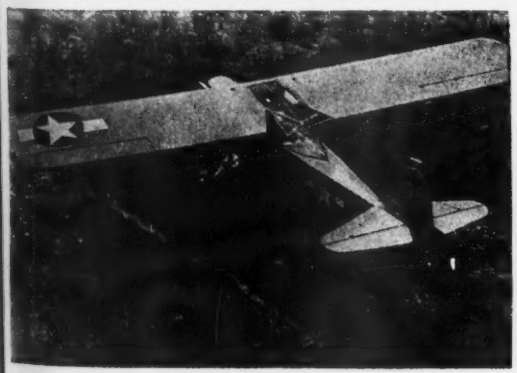

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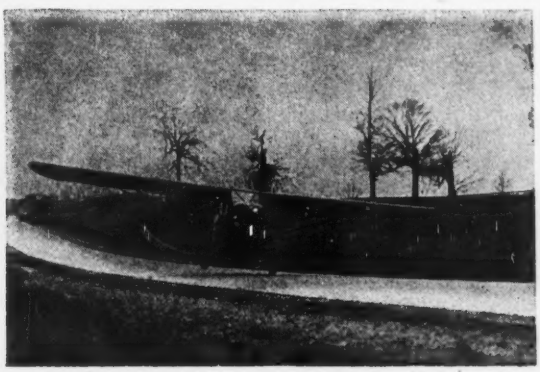

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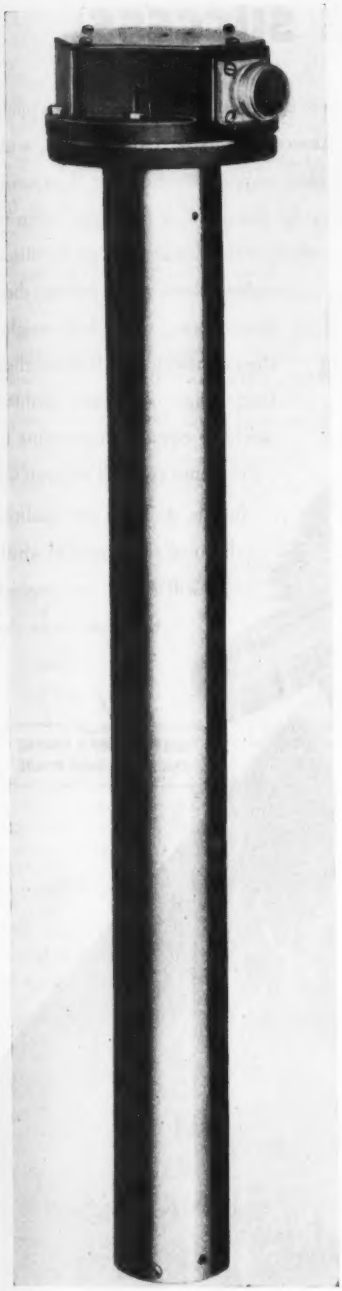

FIG. 10. Capacitor-type tank unit and vacuum tube capacitance measuring device.

Reduction of Amount of Unmeasured Gasoline

The float-type gage leaves about an inch of fuel unmeasured at both the top and bottom of the tank because of the space required by the float. The capacitor tank unit can be designed so that all the gasoline in the tank will be measured, provided the unit is properly installed in the tank. By curving the edges of the condenser plates, it is possible to measure the fuel completely to the top and bottom of the tank.

FIG. 11. Capacitor-type indicator unit.

Reliability

Laboratory tests show that operation of a system such as that shown in Fig. 10 for a period of 422 hours under conditions of $^1/_8$ in. vibration at 1,800 cycles per min. is stable. The change in indication as a result of this test was 0.9 per cent. An indicator such as that shown in Fig. 11 was used. Actual flight tests have been successful.

CONCLUSIONS

A method of indicating fuel quantity in aircraft by a capacitance measurement method has been described. The advantages, disadvantages, and possibilities of such a system have been discussed. Because this method is practical, development should be continued.

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[2] Moeller, R. C., *How to Calibrate Aircraft Fuel Tanks*, Aero Digest, Vol. 41, No. 5, pp. 139, 140, 263, November, 1942.

(*Continued from page 11*)

dynamics in the development of an efficient low-cost glider.

GLIDER CHARACTERISTICS

Because of the interdependence of the two members of the tug-tow combination in all conditions of towed flight, a proper relationship must be established between the characteristics of the tug and the glider.

The characteristics of a good tug are such that the characteristics of the glider should be: (1) gross weight, 17,700 lbs.; (2) useful load, 10,200 lbs.; (3) top tow speed or free flight speed, 200 m.p.h.; (4) stalling speed with flaps, 55 m.p.h.; (5) length of run on paved runway after landing at minimum speed, 400 ft.; (6) rate of sink at 85 m.p.h., 1,100 ft. per min.; (7) wing loading, 17 lbs. per sq.ft.; (8) thrust horsepower per lb. of pay load at 150 m.p.h. (this to be measured at the glider), 0.045 t.hp. or less.

(9) Provision shall be made for dual controls. (10) A complete set of flying instruments is to be provided, including an automatic pilot for towed flight. (11) A two-way radio is required with channels covering tug aircraft, control towers, and company radio facilities. (12) The glider shall have satisfactory controlability, stability, and maneuverability under all design conditions of take-off and landing and towed or free flight. Particular attention must be given the stability of the aircraft in towed flight at all speeds. The relationship of applied tow-line forces to the normal moments about the reference axis of the aircraft deserve careful analysis.

TUG CHARACTERISTICS

There are a number of aircraft now in existence that perform fairly satisfactorily as tug aircraft. The C-47, C-60, C-46, and B-17 have been thoroughly explored as tugs, and test work has also been carried out on such aircraft as the P-38, B-24, B-25, and some single-engined aircraft.

As the test data and field service reports were analyzed, it became apparent that the military glider was designed without any consideration being given the characteristics of the military tugs, and train performance suffered in direct proportion to spread in wing loading, $C_{lmax.}$, cleanliness between the tug and the glider, upon the power and wing loadings of the tug, and also maximum L/D speed.

Sufficient operating experience has been accumulated to permit an examination of the design requirements of tug aircraft.

A tug designed to move an 18,000-lb. glider both in tow and in pickup must have a mass relationship of not less than $2^1/_2$ to 1 with the glider. The tug must have an excess horsepower of 20 per cent more than that necessary to climb the tug at 900 ft. per min. when loaded to standard gross.

The mass required in the tug for towing and pickup operations can be utilized to develop the tug as a standard cargo aircraft.

A multipurpose aircraft, capable of being used efficiently as a cargo aircraft, as a pickup ship for dead-weight pickup service, and as a glider tug, would be ideally suited to on-line and radiating cargo service by common carriers and could also be used successfully by charter operators and contract carriers.

The tug design characteristics should be as follows: (1) standard gross, 45,000 lbs.; (2) weight empty, 22,500 lbs.; (3) three engines (preferably liquid-cooled); (4) airfoil center section; (5) cargo section, 25 ft. long by 10 ft. wide by 6.5 ft. high. (6) Floor loading (of cargo section), 150 lbs. per sq.ft.; (7) cargo section to run laterally across center section; (8) cargo doors, 5.5 ft. high by 6 ft. wide, to be located at each end of the cargo section and to be not more than 41 in. above the ground; (9) wing loading, 30 lbs. per

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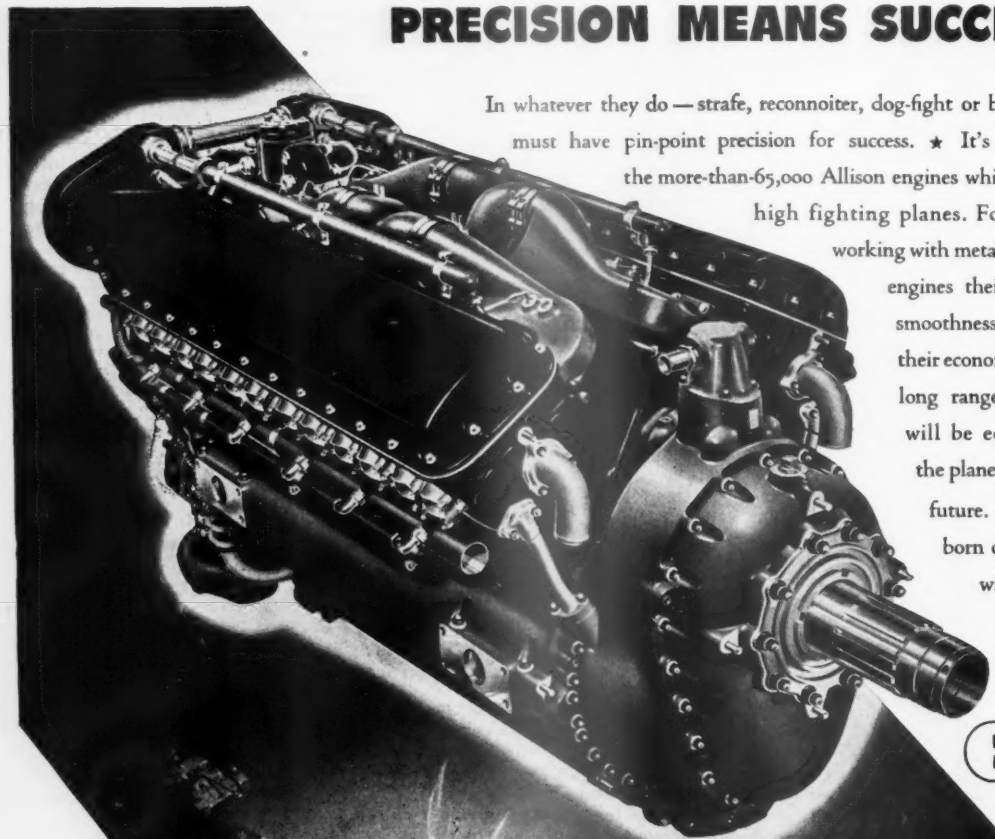

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sq.ft.; (10) power loading, 10 lbs. per hp.; (11) take-off at standard gross over 50-ft. obstacle, 1,800 ft.; (12) landing at standard gross over 50-ft. obstacle, 1,800 ft.; (13) rate of climb at sea level at rated hp., 1,200 ft. per min.; (14) stalling speed with flaps, 70 m.p.h.; (15) true air speed at 60 per cent rated hp. at 8,000 ft., 175 m.p.h.; (16) cruising range with 1,300 gal. of fuel and 13,000 lbs. of cargo at 50 per cent rated hp., 1,500 miles; (17) service ceiling at standard gross, 22,000 ft.; (18) two-engined ceiling, 12,000 ft.

(19) The crew is to consist of a pilot, copilot, radio operator, and flight engineer. The control cabin shall contain standard flight instruments, flight aids, engine instruments, and communications equipment. (20) The pickup engineers' station and equipment shall be located aft of the cargo compartment with a bottom turret to permit the engineer full view of the pickup operation. (21) The glider tow point shall be located on the bottom of the aft section of the center section. (22) A work well shall be installed through the bottom of the center section to permit dead-weight cargo to be reeled in and handled after pickup and to permit cargo dropping.

(23) Special features shall include: (a) tricycle gear; (b) heat-transfer deicing; (c) heat and refrigeration for the cargo section; (d) sanitary facilities; (e) complete system of cargo tie-down points; and (f) overhead crane rail, capacity 1 ton.

Air-train operations with the above combinations should produce a total cost per ton-mile of not more than 15 cents. The dead-weight pickup and straight cargo operations should be equally economical.

(*Continued from page 25*)

In on-course operations, the handling characteristics of the aircraft become important in the air as well as on the ground. Accurate air handling is necessary in order to land the aircraft where it is intended under the various conditions of cross winds or following winds that may obtain.

Glide-Path Control

In addition to reasonably slow landing speeds and adequate control in the slow speed range, the aircraft should have a means for varying its aerodynamic cleanness so that its glide path can be controlled through a wide range of angles. The usual landing flaps partially accomplish this purpose, but they are not variable and, being tied in with the overall lift, cannot be operated as a glide-path control. A separate and independent means of imposing drag to kill excessive speed is needed if the aircraft is to be landed exactly where it is wanted every time. Methods of rapidly decelerating aircraft have been developed for military purposes. Their adaptation to air-line use can save a great amount of taxiing time by permitting more accurate landings.

If we start with an improved set of inherent flight characteristics for the aircraft and develop a complementing set of operating procedures that will take full advantage of these improvements, we find that the landing-space requirements are greatly reduced.

Runway Requirements

For smaller towns a single runway should be sufficient. For larger towns and smaller cities the airport should not have more than two runways and these runways should be only long enough to comply with the failure of the one-engined take-off requirement of the C.A.A. for the type of aircraft being used.

There is a general feeling among pilots that extra runway length is all to the good and, if only 2,500 ft. are needed, that it is well to have 10,000 ft. These same pilots will always taxi to the end of this long runway for the take-off, even though it means taxiing an extra mile and losing several minutes of time.

In a recent flight it was necessary, under the traffic pattern that obtained that day, to taxi more than 2 miles to get to the loading ramp and $1^1/_2$ miles to get back out to the take-off position. This $3^1/_2$ miles at a taxi speed of 30 m.p.h. cost the flight a 7-min. loss. Taxi distances of this order are not unusual, and with the present tendency to build larger and more complicated airports the situation is getting worse. For air-line operations where landings are reasonably frequent, such loss of time becomes a great handicap.

Transoceanic and transcontinental terminals will need to be large, but many people are thinking in terms of airports that are larger than actually will be needed. For small and medium-sized towns of from 10,000 to 100,000 population, runways of from 5,000 to 10,000 ft. in length are going to be a hindrance rather than a help when we try to bring them air transport service.

This statement is based upon 18 months of operating a feeder air service for the Air Transport Command, furnishing cargo service to stations situated on large military airdromes located relatively close together. The average distance between stations was approximately 50 miles, and our aircraft spent about as much time on the ground at these airports as they did in the air.

Recently, I laid out an extensive operation of the feeder type, designed to bring air service to some 247 cities and towns in the Pacific Coast region. In this setup, if the airports were doubled in size over the minimum required, the operating cost would be increased several cents per mile, and the schedules would be slowed up enough to affect seriously the overall justification of the service.

Cost of Large Airports

There are many other good arguments against large airports. They are expensive both to build and to maintain, and a substantial part of these costs will have to be borne by the air lines. Their size requires that they be located farther away from the town, thus seriously affecting their usefulness and the amount of traffic that can be generated through them. But actual operating experience is revealing the strongest argument against them—the loss of time in getting a schedule through a landing station.

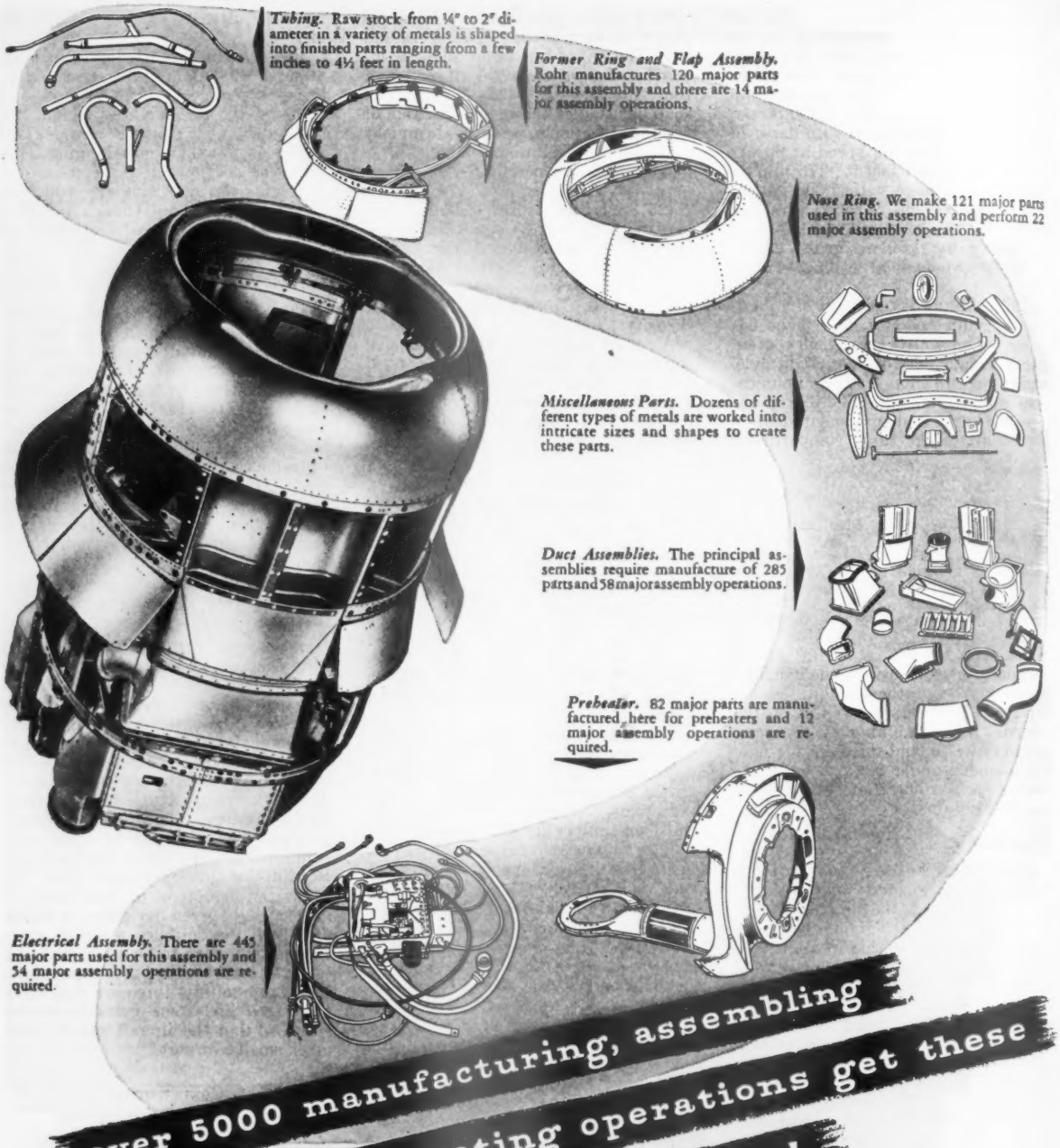
Aircraft Design

Our engineers, in designing the new transport aircraft that will be used after the war, are interested in getting a low cost per seat-mile. On paper, the way to do this is to build a clean, clipped-wing airplane with a comparatively small amount of power in proportion to its gross weight. This aircraft would require long runways to get into the air. There is no doubt but that this is right for a long-range aircraft that will be used to span the oceans or fly transcontinental traffic with one or two landings. But in the smaller aircraft that will carry the hundreds of thousands of passengers between our cities on flights of only 100 or so miles, a serious compromise will have to be made with the above formula to adapt it to these needs. The compromise will require that extra wing area and some extra power be added so that the aircraft can fly from much smaller airports.

Conclusions

These savings of time are great enough to be important. On the existing trunk lines, the speeding up of schedules would improve service to the extent that considerable additional traffic would be gained which might otherwise utilize superspeed rail or automobile transport. Also, the increased utilization of the aircraft and the decreased maintenance costs would reduce total operating costs as much as several cents per mile.

On air lines of the feeder type, it seems doubtful that successful operations will be possible if landing stops take as long as the trunk air-line stops are averaging now. Where landings are made as frequently as every 50 miles, not more than 5 min. can be allowed per landing if the schedules are to be fast enough to compete with ground transportation.


Tubing. Raw stock from ¼" to 2" diameter in a variety of metals is shaped into finished parts ranging from a few inches to 4½ feet in length.
Former Ring and Flap Assembly. Rohr manufactures 120 major parts for this assembly and there are 14 major assembly operations.
Nose Ring. We make 121 major parts used in this assembly and perform 22 major assembly operations.
Miscellaneous Parts. Dozens of different types of metals are worked into intricate sizes and shapes to create these parts.
Duct Assemblies. The principal assemblies require manufacture of 285 parts and 58 major assembly operations.
Preheater. 82 major parts are manufactured here for preheaters and 12 major assembly operations are required.
Electrical Assembly. There are 445 major parts used for this assembly and 54 major assembly operations are required.

over 5000 manufacturing, assembling and inspecting operations get these power plants ready to fly!

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Institute News

Gifts to the Aeronautical Archives

A. Roy Knabenshue gave a scrapbook containing photographs of early pilots, and copies of *Some Aeronautical Experiments*, 1901, and *Experiments and Observations in Soaring Flight*, 1903, by Wilbur Wright, both of which were presented before the Western Society of Engineers. J. J. Green, of the Air Transport Board of Canada, sent a special edition of the Portsmouth, England, *Evening News*, issued in 1931 upon the occasion of the last Schneider Trophy Contest.

A tie clasp set of Northeast Airlines was received from that company through the courtesy of S. J. Solomon. Insignia of the Fleet Air Arm were received from the British Admiralty Delegation through the courtesy of Lt. J. P. M. Reid. Mrs. Bella C. Landauer gave a French plate showing three children in an airplane and added several books to her previous generous gifts. An early insigne of the U.S. Air Service Command was received from John M. Beery, who also sent a survey of jet propulsion compiled by the Argus Research Corporation. A metal-covered paper strip dropped by the Luftwaffe in the suburbs of London, during the summer of 1944, to jam Allied radar detectors, was received from Berneice H. Jarck, with other gifts.

A tenth anniversary catalog and history of Fokker Nederlandsche Vliegtuigenfabriek, 1919–1929, and a catalog of Aviolanda Maatschappij voor Vliegtuigbouw were received from Louis Bruchiss. Dr. Alexander Klemin sent 15 pamphlets on the aviation industry from 1928 to 1940, adding to his previous generous gifts. The Civil Aeronautics Administration gave a complete file of its publications on airports, and reports and manuals. The Eclipse-Pioneer Division of Bendix Aviation Corporation sent five cartons of periodicals, adding to previous gifts. Bendix Helicopter, Inc., sent periodicals through the courtesy of C. L. Morris. The British Air Commission in Washington added 35 *British Air Ministry Translations* to the large number previously given.

Twelve copies of a report on the proposed British College of Aeronautics were received from the Ministry of Aircraft Production through the courtesy of Sir Roy Fedden. Four copies of the *Aero Digest Blue Book* were sent by Frank A. Tichenor. The Texas Company gave its publication, *Fuel Injection in Spark-Ignition Otto Cycle Engines*, by M. P. Doss.

Application, briefs, and exhibits relating to proceedings before the Civil Aeronautics Board with regard to new air routes and extensions of existing routes were received from the American South African Line, Inc.; Braniff Airways, Inc.; Eastern Air Lines, Inc.; Grace Line, Inc.; Hawthorne Airways; Mid-Continent Airlines, Inc.; Northwest Airlines, Inc.; Otto Airlines; Parks Air Transport, Inc.; Southwest Airways Company; Spartan Airlines, Inc.; Transcontinental & Western Air, Inc.; Transoceanic Air Lines, Inc.; U.N. Airships, Inc.; United Air Lines, Inc.; Lawrence W. Van Ryn; and Zimmerly Air Transport.

Additional gifts were received from the British Information Services; Civil Air Patrol League, Inc.; Fuerza Aerea de Chile; The Glenn L. Martin Company; Norma-Hoffmann Bearings Corporation; Pan American Airways, Inc.; Polish Information Center; Tennessee Eastman Corporation; Trans-Canada Airlines; E. P. Warner; and the U.S. Fourth Air Force; David Taylor Model Basin, U.S.N.; Department of State; Division of Aeronautics of the Library of Congress; Office of Civilian Defense; War Production Board; and the House and Senate Document Rooms.

New Corporate Members

The following are brief summaries of the products and activities of companies that have recently become Corporate Members of the Institute.

Agawam Aircraft Products, Inc., Sag Harbor, L.I., N.Y., was organized in December, 1940, to make precision parts for airplanes. Products manufactured consist of all kinds of metal fittings—steel, aluminum, magnesium, and bronze—as well as small assemblies and controls. The entire production of this company has been consigned to Grumman Aircraft Engineering Corporation of Bethpage, N.Y.

The plant is located on the waterfront at Sag Harbor, where the company has constructed an airplane ramp, which has been designated by the Civil Aeronautics Administration as a seaplane and amphibian station. It is therefore possible for Grumman amphibians leaving Bethpage to land at the plant, thereby connecting the two factories by air.

Magnaflux Corporation, of Chicago, has been closely associated with the aeronautical industry since the earliest days of its existence. In fact, the growth in the use of the magnetic-particle inspection method has coincided with the expansion of the aeronautical industry that has taken place within the last 10 years.

The corporation has devoted its energies and facilities for research and development to the more effective use of this inspection method in the aeronautical industry. It has also sponsored some promising new methods of nondestructive testing, including two developments that have proved of interest and value in the field of aircraft construction and maintenance. The first of these is the method of locating flaws in nonferrous castings and forgings based on the use of a fluorescent penetrant. This method offers, in the field of nonmagnetic materials, the same opportunity for locating surface cracks and flaws which the magnetic-particle method provides for iron and steel materials.

The second development is the brittle-lacquer method of experimental stress analysis which has been widely applied for the purpose of redesigning and strengthening various critical engine and aircraft parts, usually with a net saving of weight.

Owens-Corning Fiberglas Corporation, Toledo, is the producer of Fiberglas, which is the trade name for glass manufactured in fiber or filament form. Woven into textiles that may receive further processing or shaped into wool-like bats that may also be treated, Fiberglas products have many applications for the aircraft industry.

Fiberglas textiles combined with suitable impregnants offer various physical and electrical characteristics and contribute important space- and weight-savings for electromagnetic equipment on aircraft.

Some of the more important applications are in motors, generators, starters, inverters, dynamotors, ignition cables, power and lighting cables, and radio connection wire. Fiberglas bats and blankets are an acoustical and thermal insulating material for aircraft. They are fire-resistant, have low moisture pickup, and are extremely light in weight. Reinforced plastic materials are being incorporated in aircraft as formed parts and structural members. They combine strength with light weight. Some of the most important applications are in wing liners, cargo kick boards, ducts, scoops, and helicopter cabins. Synthetically coated cloths and decorative fabrics find application on aircraft where durability, strength, fire safety, and attractive appearance are required. They are used in flexible ducts, bore-sight screens, firewall gaskets, and covers.

U. S. Signal Corps photo

The Aim is... ACCURACY!

Tanks and tank destroyers now serve a dual function . . . for close range fire-power and as mobile, armored artillery units with an effective range of several miles.

A precision aiming device . . . called the *AZIMUTH INDICATOR* . . . enables the crews of tanks and tank destroyers to quickly adjust a gun turret to a direct horizontal and, with the aid of reconnaissance planes, the device accurately and quickly courses the aiming for the transverse position.

The *azimuth indicator* (illustrated) is made by the Beam Manufacturing Company of Webster City, Iowa. The rubber parts (illustrated) are produced for "Beam" by The Ohio Rubber Company. Like all components of the *azimuth indicator*, these rubber parts must conform to rigid standards.

From beginning of manufacture to "end use" of the *azimuth indicator*, the aim is ACCURACY. When *YOUR* aim is accuracy in mechanical molded and extruded rubber or synthetic rubber parts—call for—

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THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO

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Sciaky Brothers, of Chicago, began experimenting in France on a better method of spot-welding aluminum. As the high currents were needed for only 100 sec. out of every hour, some method of storing up energy seemed to be the solution. Considerable research proved that an electromagnetic means of storing the energy was best for the job. In 1928, the firm produced what was credited as the first stored-energy spot welder and was rewarded with wide acceptance by continental aircraft plants. Further refinements included a variable pressure cycle, essential to the production of metallurgically sound aluminum welds.

This process was introduced to the United States in 1939 and was immediately adopted by major airplane manufacturers. After the fall of France, the U.S. Navy expedited the transfer of the Sciaky enterprise to America, and the Pullman Company supplied space until the firm could start its own branch in the Chicago area. At first, only secondary structures and assemblies such as ammunition boxes, window frames, etc., were spot-welded. Then, as engineers gained more knowledge of its capabilities, spot welding was extended to primary structures such as longerons, beams, and wing skins.

Since the company's arrival in America, it is reported to have produced 80 per cent of all stored-energy welders now operating in aircraft plants. These include press and rocker-arm types, portables, and what is stated to be the largest spot welder ever built—a 240 kw. machine for welding aluminum up to $^3/_{16}$ in. New developments include the "Three-Phase" welders, welding armor plate, and seam-welding aluminum on a balanced three-phase load.

Sections and Branches

Los Angeles Section

A technical meeting of the Los Angeles Section was held on March 2 in the Hancock Auditorium of the University of Southern California with 242 members present. Philip Colman presided and introduced Major R. H. Fleet, who in turn introduced Dr. Clark B. Millikan, Hall L. Hibbard, Dr. J. C. Hunsaker, and Dr. George W. Lewis, Past-Presidents of the Institute, and Bennett H. Horchler, Executive Vice-President of the Institute.

John Stack, of the National Advisory Committee for Aeronautics, presented his paper "Compressible Flows in Aeronautics," which he had given as the eighth Wright Brothers' Lecture.

Phoenix Section

Following a dinner at the Adams Hotel, a business meeting was held on February 23 at which the following officers were elected: Chairman, E. R. Hawley; Vice-Chairman, Stuart H. Hahn; Secretary, Arthur N. Paul; Treasurer, R. H. Blakeley. The Advisory Committee also was elected: R. N. Hartwick, Benny Moeur, G. O. Pranspill, and J. T. Harris. Thirty members and guests attended the meeting.

Texas Section

The Texas Section held a meeting at the Blackstone Hotel at Fort Worth on February 9, with 28 members in attendance. The guest speaker was Dr. John H. Frederick of the University of Texas who spoke about "Air Transportation."

Wichita Section

An organization meeting of the Wichita Section was held on February 15 at the University of Wichita. The following officers were elected: Chairman, Jack C. Jones; Vice-Chairman Walter Burnham; Secretary, Kenneth Razak; Treasurer, R. W. Allred.

The Advisory Board was elected, comprising Walter Krause, Wilfred Pierce, Herbert Dewese, Dr. P. S. Albright, and Tom Salter.

The Membership Committee consists of Charles Jameson, George Baughman, Herb Kueck, and Bill Gray. The Meetings and Papers Committee has Walter Burnham as Chairman and the members of the Advisory Board as Committeemen. This meeting was devoted entirely to business matters.

Aeronautical University

Two business meetings were held: one on February 20 and the other on February 27. Both meetings were given over to discussion of increasing the membership and selecting committees to secure speakers and motion-picture films for future meetings. The full membership attended both meetings; R. V. Smietanski was the Presiding Officer.

Illinois Institute of Technology

A technical meeting of the Illinois Institute of Technology Branch was held on February 7 in Chapin Hall; this was a joint meeting with the branch of the American Society of Civil Engineers.

A talk on "Concrete Hangar Construction" was given by Anton Todesko of the Roberts-Schaefer Company, Chicago. The lecture was illustrated by lantern slides. Thirty-eight members attended.

Indiana Technical College

On February 8 a technical meeting was attended by 20 members and guests from the Indiana Technical College Branch of the American Society of Mechanical Engineers. Gordon Grose, a student member, gave a talk on the theory, development, and use of the autogiro. The film titled *Plexiglas*, from the Rohm & Haas Company, and another titled *All Work and No Play*, from the Boots Aircraft Nut Corporation, were shown.

The Winter Term dinner and technical meeting took place on February 22 at the Fort Wayne Y.M.C.A. Albert L. Shurtz, Manager and Instrument-Training Instructor of the Airgo Division of the Consolidated Aircraft Repair, Inc., spoke on "Airport Instrument Approach." The films *Messerschmitt Me-110* and *Unfinishing Rainbows* were shown.

Iowa State College

A joint business and technical meeting on February 12 was attended by 30 members. The film *Target for Today* was shown. The following new officers were elected: Chairman, William Henzlik; Vice-Chairman, Paul Petersen; Secretary-Treasurer, Calvin Wadleigh; Program Chairman, Kent Hawkins.

Casey Jones School of Aeronautics

With an attendance of 16 members, a business meeting was held on February 2, with George Grabowski presiding. Nominations were made for student officers. On February 8 an election of officers took place, 14 members being in attendance.

At a business meeting on February 16 the Treasurer's report was given and the motion picture *Lightning P-38* was shown.

Massachusetts Institute of Technology

Dr. Jerome C. Hunsaker was the presiding officer at a technical meeting of the M.I.T. Branch held on February 2; attendance was 300. John Stack, of the National Advisory Committee for Aeronautics, gave a talk on "Supersonic Compressible Flow." Motion-picture films dealing with N.A.C.A. research on high-speed airflows were shown. This was the first time, other than at Wright Brothers' Lectures, that these films were exhibited.

A business meeting on February 7 was attended by 50 members. The following officers were elected: Chairman, Duncan Luce; Vice-Chairman, Henry W. Pickford; Secretary-Treasurer, Frank L. Carroll; Activities Chairman, Richard L. McManus.

University of Minnesota

A joint technical and business meeting was held on February 1 at the Coffman Memorial Union. Thirty members attended. Prof. John D. Akerman gave a talk about pressure suits used for high-altitude flying.

The meeting on February 10 was a social function; 26 members and guests traveled by sleigh to Eton's Ranch for dancing and refreshments.

(*Continued on page 47*)

LEAR

Electro-Mechanical Actuators and Electrical Controls

Remote Positioning Controls —Electro-Mechanical Actuating Devices — Modulating Automatic Temperature Controls — High-Output, Lightweight Gear Mechanisms — Low-Weight Electric Motors and Power Units with "Fastop" and quick release Magnetic Clutches — Flexible Power Shafting — Screw Jacks.

Lear units today are giving reliable service on airplanes in operating wing flaps, cowl-flap shutters, landing gears, radiator shutters, bomb-bay doors, air-filter shutters, propeller controls, oil-cooler shutters, supercharger gear changers, intercooler shutters, trim tabs, cargo-loading doors and others.

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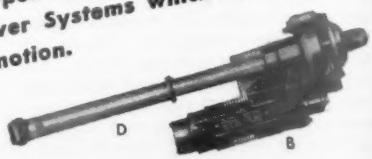
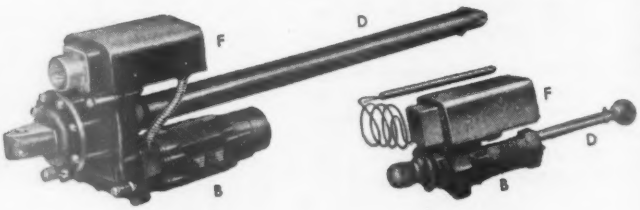
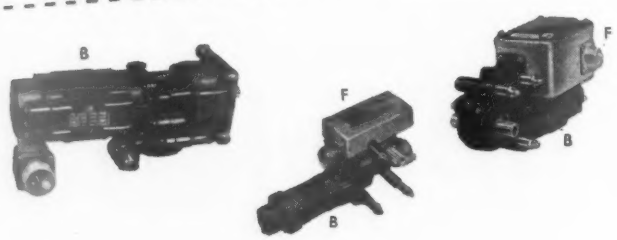
West Coast Subsidiary: Lear, Inc., of Calif. 1010 N. Highland Ave., Los Angeles 38, Calif.

There are three basic types of Lear Electro-Mechanical Actuators and Power Systems which convert electrical energy into motion.

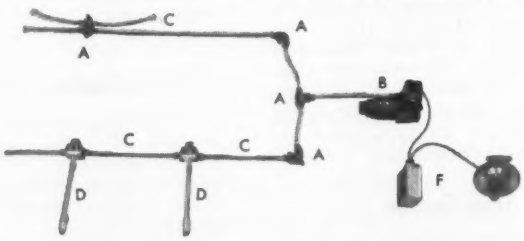




1. *Lear Linear Actuators. These produce powerful pull and thrust through a motor, magnetic clutch, gear train and screw jack. Though weighing but 4 to 15 pounds, they can take static loads up to 7½ tons and produce operating forces from 340 pounds to 10,000 pounds.*

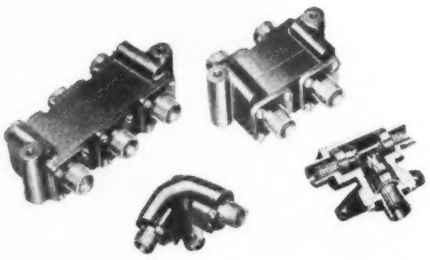


2. *Lear Rotary Actuators. The Lear motor and gear train operate a rotating shaft to which an arm is attached. Motion is through an arc which is adjustable to various needs. These provide fast operation with torques from 10 inch-pounds to 1200 inch-pounds or more.*



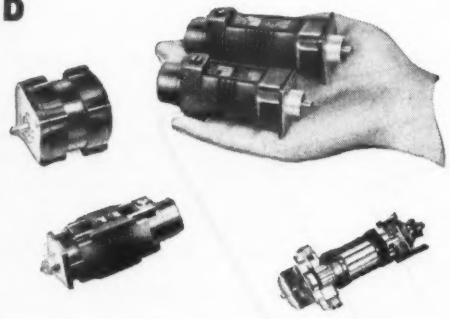
3. *Lear Flexible Shaft Systems. Without exposed parts these systems transmit power through congested space and produce motion at a distance from the source of power. The Lear Power Unit is mounted where space permits and Lear Flexible Shafting carries the force to points where screw jacks convert the spinning motion into a powerful push and pull. All the parts fit quickly together—cost little to install.*

A



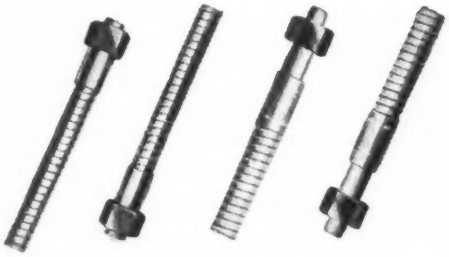
Lear Couplings allow the branching and abrupt turning of Lear Flexible Shafting. Their gears are precision-built.

B



Lear Motors weigh as little as .68 of a pound, producing 1/40 of a horsepower, and up to and beyond one that weighs only 16.7 pounds, yet produces 3 horsepower. They are equipped with the Lear "Fastop" electromagnetic clutch and brake which stop the driving motion in a fraction of a second, and with protection against overheating.

C

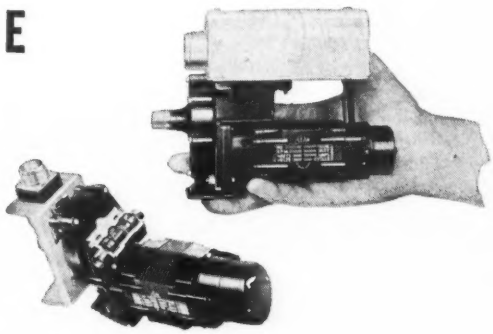


Lear Flexible Shafting reliably transmits power while turning in either direction. It can do the work of solid shafts, pulleys, torque tubes, sprockets, belts and chains.

D

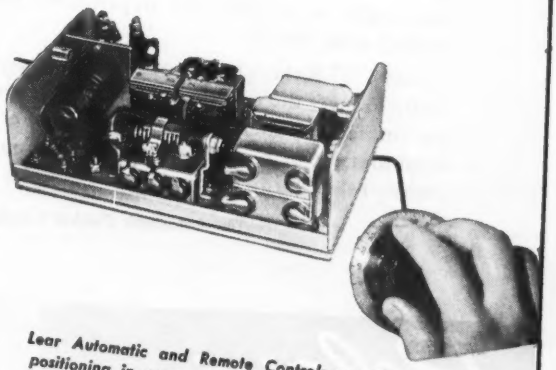
Lear Screw Jacks convert spinning motion into extending and retracting motion. They move in a straight line at the speed and power and distance suited to specific needs.

E



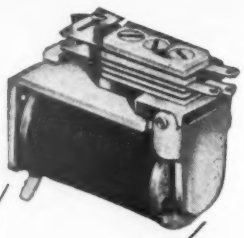
Lear Power Units consist of the Lear Motor and a gear train. They have single or double power take-offs, weigh approximately 3½ to 11 pounds and provide operating forces from 4 to 800 inch-pounds.

F



Lear Automatic and Remote Controls provide accurate positioning in response to manual operation or changes in temperature, pressure, altitude, speed or position.

LEAR, INCORPORATED • PIQUA, OHIO



When a lot of stamina must fit a little space

IF SPACE requirements dictate a small relay —and service conditions a powerful one... here's the relay to fit your needs. It's the Automatic Electric Class "S" Relay—tiny in size, light in weight, but dependable and packed with power.

Class "S" Relays have been designed especially to meet the exacting conditions of service on fast, modern aircraft. They offer a combination of features never before found on any relay, large or small. For example:

1. **Vibration-resistance is not just "added on"—it's designed right into Class "S" Relays. And they withstand with a large margin of safety the most rigorous operating tests of the Signal Corps and the Air Forces.**
2. **A unique spring design provides high contact pressure within small space limits.**
3. **An added assurance of reliability is provided by twin contacts.**
4. **The new type of pin-pivoted armature with full length bearing provides the Class "S" Relay with exceptionally long life even under the toughest conditions.**

The Automatic Electric Catalog gives full details. Write for your copy.

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AND OTHER CONTROL DEVICES
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University of Notre Dame

After a dinner at the Hotel Hoffman in South Bend, the Notre Dame Branch held a technical meeting. Thomas Delker, a graduate of the first aeronautical class of the University and now with the Detroit branch of Bendix Aviation Corporation, spoke about the problems confronting the salvage engineer and discussed the transition of a student into his work as a full-time engineer.

Prof. Frank N. Brown, Head of the Department of Aeronautics, spoke about his trip to China on behalf of the U.S. Government and his experiences in helping to organize the Chinese aeronautical engineering system.

A humorous song, composed by the students and having 16 verses about the Aeronautical Department and its professors, was played and sung by a group of eight students. The February issue of the department's class paper, *The Burble*, contains a chronicle of the activities of the aeronautical students and several interesting articles. A list of the Notre Dame aeronautical alumni is included.

University of Oklahoma

At a meeting of the University of Oklahoma Branch on February 12, L. A. Comp, who is on leave of absence as Professor of Mechanical Engineering at the University and is now employed at Douglas Aircraft Company, Inc., gave a talk about the organization of an engineering department in an aircraft company.

A business meeting followed at which the following officers were elected: Chairman, C. R. Howard; Vice-Chairman, N. D. Nolan; Secretary-Treasurer, R. F. Lemon.

Tri-State College

The following officers were elected at a business meeting of the Tri-State College Branch on January 22: Chairman, H. Kijowski; Vice-Chairman, W. Grome; Secretary-Treasurer, K. Klopfenstein.

On January 29, Professor Hohenshau spoke about the "Opportunities as an Electrical Engineer."

A technical meeting was held on February 19 at the college auditorium. The film *Fortress in the Sky* was presented.

Virginia Polytechnic Institute

A technical meeting of the Virginia Polytechnic Institute Branch on February 15 was attended by 30 members. Prof. L. Z. Seltzer, Faculty Advisor, explained the functions of the Institute to the new members. The films *Fortress in the Sky* and *PT-19 Trainer* were shown.

Twelve members attended a business meeting on March 1. The following officers were elected: Chairman, B. P. Brown; Vice-Chairman and Treasurer, H. J. Curfman, Jr.; Secretary, R. R. Morrissette; Faculty Sponsor, Prof. L. Z. Seltzer.

News of Members

Warren A. Anderson has been commissioned an Ensign in the U.S. Naval Reserve.

Robert J. Arenz has joined Douglas Aircraft Company, Inc., as an Engineering Assistant.

Emric W. Bergere is now associated with Aviation Service Company as Chief Engineer.

J. R. Bradley has become connected with Robert Keith, Inc., as a Department Head.

William J. Colson was recently appointed Lead Engineer of Preliminary Design at Boeing Aircraft Company.

Edward Cosbey, Jr., has joined the Stout Research Division of Consolidated Vultee Aircraft Corporation as an Aeronautical Engineer.

Ward F. Davidson, Director of Research of Consolidated Edison Company of New York, has spent a large part of his time during the past 3 years at the office of the Chairman of the National Defense Research Committee in Washington. He now performs the duties of Deputy Executive Officer there.

George A. Doole was recently appointed Assistant Chief Pilot in charge of personnel at the transatlantic headquarters of Pan American World Airways at La Guardia Field, N.Y.

Malcolm P. Ferguson, Vice-President of Bendix Aviation Corporation, has been elected a Director of the company.

Joseph J. Gilgan has been appointed Stress Engineer at Douglas Aircraft Company, Inc.

Brewster A. Gillies, formerly Director and Vice-President of Grumman Aircraft Engineering Corporation, has been appointed to the dual position of Assistant to the President and Director of Flight and Service of the Ryan Aeronautical Company.

James L. Glascock has received his commission as an Ensign in the U.S. Naval Reserve.

Richard M. Head is now on duty as an Ensign in the U.S. Naval Reserve.

Brig. Gen. Albert F. Hegenberger has succeeded Brig. Gen. Edgar E. Glenn as Chief of Staff of the U.S. 14th Air Force, with headquarters at Kunming, China.

Maurice Holland, formerly Director of the Division of Engineering and Industrial Research of the National Research Council, has been appointed Industrial Research Adviser to the Midwest Research Institute, of Kansas City, Mo. He will serve the Armour Research Foundation, of Chicago, in a similar capacity.

Joseph Kemper is now an Aeronautical Engineer with the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics.

Jack J. Lane is now a Tool Engineer with Aircraft Tools, Inc.

Oscar T. Larson has been appointed Assistant to the Vice-President of Operations of United Air Lines.

Maurice E. Long has received a commission as a Lieutenant (j.g.) in the U.S. Naval Reserve.

Arnold O. Ostrand has joined Otis Elevator Company as Aircraft Stress Analyst.

Frederick F. Robinson, formerly Vice-President and Secretary, was elected President of the National Aviation Corporation.

Frank F. Russell has been elected President of the Cerro de Pasco Copper Corporation.

Peter Van Horne Serrell is now Assistant Designer at the Cooperative Wind Tunnel operated by California Institute of Technology.

Samuel S. Shaw has been commissioned a Lieutenant in the U.S. Naval Reserve.

George W. Smith, Jr., has been elected President of Smith and Wood Inc.

Robert J. Vicars has joined Hudson Motor Car Company as a Stress Engineer.

Edward C. Wells has been selected as the winner of the 1944 Fawcett Aviation Trophy and an award of $1,000.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Barton, Millard Vernon, Ph.D.; Prof. of Aeronautical Engineering, University of Texas.

Bayless, Ralph Leland, B.S. in M.E.; Chief of Aerodynamics, Consolidated Vultee Aircraft Corp.

Bromberg, Ben George, M.S.; Chief of Structures and Flight Test, Allentown Div., Consolidated Vultee Aircraft Corp.

Brow, Harold J., Commander, U.S.N.

Colman, Philip, M.S. in M.E.; M.S. in Ae.E.; Chief Aerodynamics Engineer, Lockheed Aircraft Corp.

Fisk, Albert S., Engineer in charge of product and production of Aircraft Gyropilots, Sperry Gyroscope Company, Inc.

Frische, Carl Alfred, M.S.; Ph.D.; Chief Research Director, Sperry Gyroscope Company, Inc.

Gail, Albert, Project Aerodynamicist, McDonnell Aircraft Corp.

Gordon, Samuel Arthur, B.S. in Ae.E.; Chief Structural Test Engineer, The Glenn L. Martin Co.

Simmonds, Oliver Edwin, Sir, M.A.; Managing Director, Simmonds Aerocessories, Ltd. (England).

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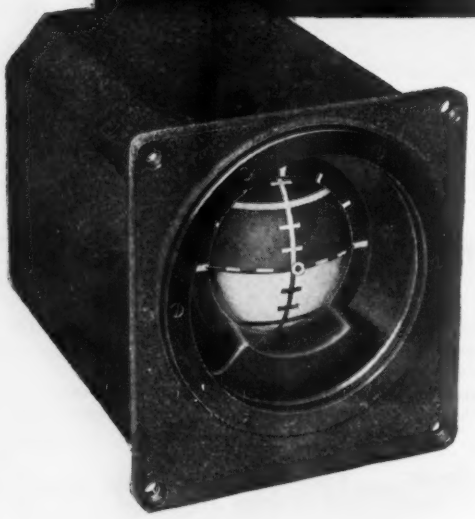

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Elected to MEMBER Grade

Anderson, Raymond Ferdinand, B.S. in Ae.E.; Aerodynamicist, Lockheed Aircraft Corp.

Ashelman, Russell Henry, B.S. in M.E.; Power Plant Engineer, Boeing Aircraft Co.

Batdorf, Samuel Burbridge, Ph.D.; Physicist, Langley Mem. Aero. Lab., N.A.C.A.

Berkowitz, Samuel Michael, B.S. in M.E.; Asst. Chief Engineer, Pennsylvania Aircraft Works.

Briggs, Edward William, B.S. in Ae.E.; Aero. Engineer, Bureau of Aeronautics, U.S. Navy Dept.

Biebel, William Joseph, B.S. in Ae.E.; Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Binford, Henry Francis, B.S. in E.E.; Electrical Engineer, Aircraft Engine Research Lab., N.A.C.A.

Carless, Harold Alfred, B.Sc.; Chief Stressman, Taylorcraft Aeroplanes, Ltd. (England).

Creech, Merl Daniel, M.S. in Engineering; Associate Prof., Mechanics, University of Oklahoma.

Fabierkiewicz, Z., B.S. in Ae.E.; Aeronautical Stress Engineer, Fleet Aircraft Ltd.

Fornasero, John Bernard, Engineering Flight Test Pilot, Boeing Aircraft Co.

Hooker, Ray Willard, B.S. in M.E.; Asst. Chief of Engineering, Service Div., Langley Mem. Aero. Lab., N.A.C.A.

Kaplan, Joseph, Ph.D.; Chief, Operations Analysis Section, U.S. Army Air Forces.

Koenig, Carl Fred, III, B.S. in E.E.; Lt. (j.g.), Project Engineer, Patuxent River Naval Air Station, U.S.N.R.

Liss, Irving Mathew, B.A.Sc. in E.E.; Design Engineer, The de Havilland Aircraft of Canada, Ltd.

Noreen, Sheldon Julius, Design Layout Engineer, Consolidated Vultee Aircraft Corp.

O'Dea, John Arthur, B.S. in M.E.; Materials Review Engineer, Curtiss-Wright Corp.

Sanders, Emil Bear, Instructor, U.S. Army Air Forces.

Steele, Crittenden Pratt, B.S. in Ae.E.; Group Engineer, Boeing Aircraft Co.

Stepanek, Vaclav, Manager of Aircraft Hoselines Dept., Prenco Progress & Engineering Corp., Ltd.

Transferred to MEMBER Grade

Batchelor, Burton Hazen, B.S. in Ae.E.; Boeing Field Service Engineer, Boeing Aircraft Co.

Becker, John V., M.S. in M.E.; Asst. Head of Compressibility, Research Div., Langley Mem. Aero. Lab., N.A.C.A.

Brewer, Walter, Jr., S.B. in A.E.; Unit Head in charge of Flight Test Instrumentation, Curtiss-Wright Corp.

Brierton, James Lawrence, B.S. in C.E.; Design Engineer, Senior, Airplane Div., Curtiss-Wright Corp.

Brock, Horace, LL.B., Chief Pilot, Latin American Div., Pan American Airways System.

Burke, Robert Earl, B.S. in Ae.E.; Chief Service Engineer, Stinson Div., Consolidated Vultee Aircraft Corp.

Castles, Walter, Jr., B.S. in A.E., Research Asst., Guggenheim Aero. Lab., State Engineering Experiment Station, Georgia Institute of Technology.

Charters, Alexander C., Jr., Ph.D.; Chief, Aerodynamics Section, Ballistic Research Lab., Aberdeen Proving Ground.

Chitwood, Harold Delmar, Lt., U.S. Army Air Forces.

Coe, John Moment, B.S. in Ae.E.; Test Engineer, Grumman Aircraft Engineering Corp.

Corner, Arthur Nathaniel, B.S. in I.E.; Executive Engineer and Assistant to the President, RotaWings, Inc.

Cushman, Maurice Edward, B.S. in Ae.E.; Project Engineer, Propeller Div., Curtiss-Wright Corp.

de Florez, Peter, B.S.; Development Engineer, American Export Airlines.

Feigen, Morris, B.S. in C.E.; Aerodynamic Research, Curtiss-Wright Corp.

Haber, Bernard D., B.S. in Ae.E.; Chief of Research Group, Structures Test Lab., Wright Field, U.S. War Dept.

Isreeli, Jack, M.S. in A.E.; Design Supervisor, Simmonds Aerocessories, Inc.

Karstens, Nicholas Van de Grift, B.S. in M.E.; Wind Tunnel Model Design Engineer, Douglas Aircraft Co., Inc.

Kiehle, Marlin H., B.S. in A.E.; Senior Flight Test Engineer, Airplane Div., Curtiss-Wright Corp.

Kincaid, F. M., Jr., B.S. in M.E.; Project Engineer, Power Section Design, Wright Aeronautical Corp.

Kyropoulos, Peter, Instructor in Mechanical Engineering, California Institute of Technology.

Miner, Milton Albert, Degree of Engineer; Strength Test Engineer, Douglas Aircraft Co., Inc.

Newmark, Marshall Floyd, Jr., B.S. in Ae.E.; Supervisor-Liaison Engineering, Consolidated Vultee Aircraft Corp.

Rane, John William, Jr., B.S. in C.E.; Ensign, U.S.N.R.

Rottmayer, Earl, M.S. in Ae.E.; Stress Analyst, Static & Dynamic Test Dept., The Dow Chemical Co.

Schoolfield, William Cleveland, B.S. in Ae.E.; Chief of Aerodynamics Dept., Chance Vought Aircraft Div., United Aircraft Corp.

Seltzer, Leon Zee, Ph.D.; Assoc. Prof. of Aeronautical Engineering, Virginia Polytechnic Institute.

Shreve, Darrell Rhea, Ph.D.; Stress Analyst, McDonnell Aircraft Corp.

Stevens, Emerson Ward, B.Ae.E.; Structures Engineer Unit Head, Airplane Div., Curtiss-Wright Corp.

Thurston, David Byron, B.Ae.E.; Experimental Design Engineer, Grumman Aircraft Engineering Corp.

Tripp, Ralph Harry, Ph.D.; Head of Structures Research, Grumman Aircraft Engineering Corp.

Wells, Robert Andrew, B.Ae.E.; Sr. Field Engineer, Wright Aeronautical Corp.

Wilkes, B. Furman, B.E. in M.E.; Lt. (j.g.), U.S.N.R., Asst. Metals Div. Officer, Naval Air Station.

Wodrich, Edmund Gillette, B.Ae.E.; Major, U.S. Army Air Forces.

Yuan, Shao Wen, Ph.D.; Research, Helicopter Div., McDonnell Aircraft Corp.

Elected to Industrial Member Grade

Ellis, John H., Engineer, AiResearch Mfg. Co.

Moeur, Benjamin Baker, Jr., A.B., Flight Instructor & Field Manager, Southwest Airways, Inc.

Pollard, Harold, Special Lecturer, University of Toronto (Canada).

Elected to Technical Member Grade

Agnew, John Daniel, Structural Engineer, Canadair Limited (Canada).

Bernhard, Maurice B., B.S. in M.E.; Test Pilot, Asst. Project Officer, Lt., U.S.N.

Broberg, Ralph Frank, B.S. in Ae.E.; Project Engineer, Engineering & Research Corp.

da Costa, Oscar, Hydraulic Group Leader, Canadair Limited (Canada).

Davis, Gene Douglas, B.S. in Ae.E.; Aircraft Engineering Officer, 2nd Lt., U.S. Army Air Forces.

Di Paola, Jane, Mrs., B.A.; Structures Engineer, Research Lab., Curtiss-Wright Corp.

Evans, Thomas Makepeace, Project Engineer, Wickman Corp.

Fried, Jerome Leonard, B.S. in Ae.E.; Liaison Engineer, Goodyear Aircraft Corp.

Glennon, John Joseph, Institute of the Aeronautical Sciences, Inc.

Hughes, Samuel Presnell, Structural Liaison Engineer, Goodyear Aircraft Corp.

Hunter, Maxwell White, Jr., M.S. in Ae.E.; Aerodynamicist, Douglas Aircraft Co., Inc.

Ingardia, Joseph Victor, B. of C.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

Martina, Albert Peter, B.S. in M.E.; Jr. Aeronautical Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Metcalf, John McDonald, Asst. Group Engineer, Boeing Aircraft Co.

Mutch, Marvin Howard.

Neff, John, B.S. in C.E.; Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Pearce, Rufus Burleson, Jr., M.S. in Ae.E.; Capt., U.S. Army Air Forces.

Ripley, Jack Clark, B.A.; Naval Aviator, Lt. (j.g.), U.S.N.

Transferred from Student to Technical Member

Carnicero, Jorge, B.Ae.E.

Hardcastle, Jane, B.S. in Ae.E.; Jr. Engineer, Curtiss-Wright Corp.

Hickson, John S., B. S. in Ae.E.; Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

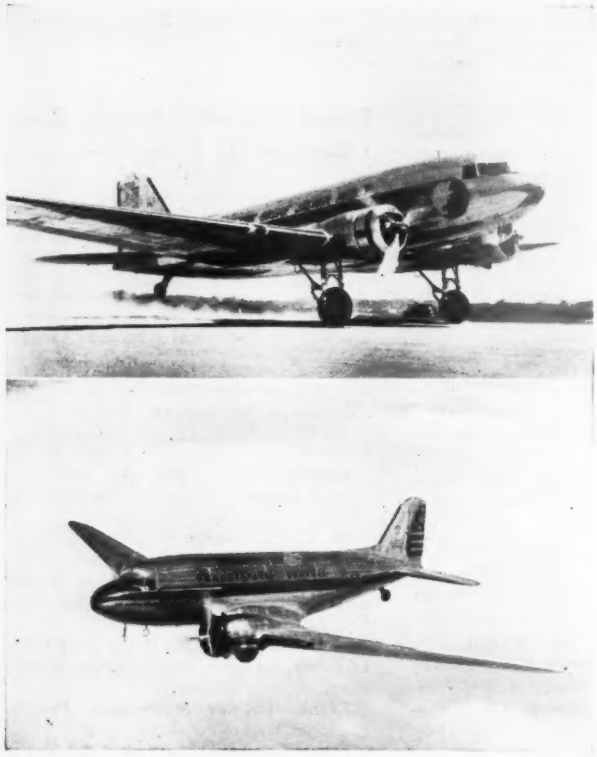
Kelly, Charles, B.S.; Apprentice Engr., Grumman Aircraft Engineering Corp.

Elected to Affiliate Grade

Averill, Robert Guyer, Lt., U.S. Army Air Forces.

Schoenen, Hermann, Source Inspector, Boeing Aircraft Co.

Tomanik, Milan Andrew, Aviation Machinist Mate 3/C, U.S.N.R.



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Necrology

Edgar Staley Gorrell

Col. Edgar Staley Gorrell, MEMBER of the Institute and President of the Air Transport Association of America, died of a heart ailment at the Georgetown Hospital in Washington on March 5, at the age of 54. He was known as a pioneer in numerous phases of aeronautical activities, being credited as the first to accomplish various achievements in Army aviation and later in organized air transport.

Colonel Gorrell was born at Baltimore, February 3, 1891, attended Baltimore City College, and was graduated from West Point in 1912. He received the Master of Science degree from M.I.T., and the Doctor of Science degree from Norwich University in 1937, both for aeronautical studies.

After serving 2 years in the Infantry he was transferred to the Aviation Section of the Signal Corps, learning to fly with the First Aero Squadron at San Antonio, Tex.

The then Lieutenant Gorrell served in the expedition against Villa in Mexico in 1916 and was promoted to the rank of Captain and served in Europe in the first World War, advancing to the rank of Colonel in 1918.

Returning to the United States in 1920, Colonel Gorrell resigned from the Army and entered the automobile business, becoming Vice-President of the Nordyke & Marmon Company and later President of the Stutz Motor Car Company. In 1934 he was appointed to the board to investigate the accidents incidental to the assignment of Army fliers to carry air mail, and in 1936 he was selected to head the Air Transport Association.

Henry Marion McFadgen

Henry Marion McFadgen, MEMBER of the Institute and Vice-President, Engineering, of Jacobs Aircraft Engine Company, died suddenly on February 8 at Miami Beach, Fla., where he had been recuperating from a heart ailment.

Mr. McFadgen was born October 12, 1887, and was graduated from the Westtown Friends Boarding School at Westtown, Pa., in 1907. From 1911 to 1925 he was a toolmaker, chief inspector, vice-president, and chief engineer with several companies in the steel and automobile businesses. In 1925 he became associated with the Jacobs Aircraft Engine Company, collaborating with Albert R. Jacobs in the organization of the company and in the design of its first aircraft engine. He was responsible for procurement and production engineering for the company and had an important part in its operations and the design of its products.

(*Continued on page 53*)

I. A. S.

Special Meetings Schedule

1945

August 16–17, 1945
LOS ANGELES MEETING

October, 1945
DETROIT MEETING

October, 1945
WASHINGTON MEETING

November, 1945
DAYTON MEETING

December 17, 1945
WRIGHT BROTHERS LECTURE, Washington, D.C.

The Officers and Council of the Institute invite participation in the Technical Sessions of the Meetings of the Institute.

The Meetings Committee will consider for inclusion on the program complete papers, or outlines or summaries of proposed papers.

Information for Participants

(1) Complete papers, or outlines or summaries should be submitted in triplicate at least four months prior to the meeting at which it is proposed to present the paper. Outlines or summaries should not exceed 1,000 words.

(2) Each paper should be so planned that it may be presented within a time limit of 45 minutes.

(3) All papers submitted will be considered for publication in the **Journal of the Aeronautical Sciences** or the **Aeronautical Engineering Review.** While a paper should be planned to take only 45 minutes for presentation at a meeting, the written presentation may have a maximum length of approximately 15,000 words.

(4) All material received will be submitted to the Meetings Committee. Authors will be notified, in ample time to prepare the complete paper, whether or not their papers can be scheduled for presentation.

All correspondence should be addressed to
The Meetings Committee
Institute of the Aeronautical Sciences
1505 RCA Building West
30 Rockefeller Plaza
New York 20, N. Y.

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Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Structural and Electronics Engineers, Aerodynamicists, Design Engineers, all grades. New, vital project, U.S.N., location New York City. Send complete résumé or call or wire for interview. Statement of availability required. Postwar continuation. Address Dean D. Smith, Fairchild Engine and Airplane Corporation, 30 Rockefeller Plaza, New York 20, N.Y.

Aircraft Engineers—Experienced aerodynamicists; structural designers; senior drawing checkers; static test engineers; layout and detail draftsmen; senior stress analysts; technical illustrators; technical writer. These positions immediately available in critical war work at attractive salaries. Postwar prospects excellent. Applicants must comply with W.M.C. regulations. Address replies giving education, experience, background, age, and draft status to C. J. Libby, Administrative Engineer, Edo Aircraft Corporation, Terminal Building, Flushing, N.Y.

Aeronautical Engineers—Experienced or semiexperienced stress, layout, and weights engineers for important positions in connection with designing of nonwrinkling sandwich aircraft structures. War and postwar applications. Write full particulars concerning education, experience, and salary requirements to Universal Moulded Products Corporation, Aeronautical Engineering Division, Bristol, Va. Attention: Dr. R. J. Nebesar.

Aeronautical Engineers, Stress Analysts, Layout and Detail Draftsman—Excellent opportunities in the Engineering Division to carry out original design work on all phases of helicopter development program. Applicants must comply with W.M.C. regulations. Write stating education, experience, age, draft status to Administrative Engineer, Kellett Aircraft Corporation, Plant #2, Upper Darby, Pa.

Engineering Pilot, with Army, Navy or Marine flight training is desired. Engineering education, preferably an aeronautical degree, pilot license to fly both single- and multi-engined airplanes is required. Pilot must pass military aero-medical physical examination as some work may involve flights at high altitudes. Address inquiries to the Chief Engineer, Curtiss-Wright Corporation, Propeller Division, Caldwell, N.J.

Aircraft Engineers—Positions available in Clifton & Caldwell, N.J., for Tool & Gage Engineers. Also engineers for manufacturing process, production methods, also design engineers, Seniors & Juniors. Manufacturing operation sheet writers, designers, tool & gage; gage analysts, tool & gage draftsmen. Applicants must have Aeronautical Industrial Manufacturing experience. Must have certificate of availability. Call in person or write Employment Office, Curtiss-Wright Corp., Propeller Division, 143 Getty Ave., Clifton, N.J.

Detail and Layout Draftsmen, Stress Analysts, and Design Engineers needed for development work in the Engineering Department. Must be citizen, not employed in essential war industry, or have a certificate of availability from the U.S. Employment Service Office or the War Manpower Commission of your area. Address inquiries to Curtiss-Wright Corporation, Airplane Division, Buffalo, N.Y.; Attention: Director of Engineering.

Detail & Layout Draftsmen, Stress Analysts, Design Engineer, Assistant Project Engineer on development work in the engineering department. Address inquiries to Edo Aircraft Corporation, 136-48 Roosevelt Avenue, Flushing, L.I., N.Y.

Engineer—Mechanical Electrical Design—To take complete charge of Engineering Department in plant manufacturing electrical automotive and aviation equipment and accessories. Experienced in and capable of low-cost production design of relays, meters, circuit breakers, switches, etc. Shop practice experience including tool design, sheet-metal work and plastics. Executive ability essential. The company seeking this man is over 20 years old, an established leader in its field, has no reconversion problem and has postwar developments which, in addition to its present line, assures permanence and security. A key job with a company with annual volume $2\frac{1}{2}$ to 3 million, affording opportunity for expansion and consequent advancement for the right man. Apply in writing giving complete personnel record and salary expected. Strict confidence assured. Address inquiries to Box 295, Institute of the Aeronautical Sciences.

Assistant Professor—To teach Mechanics, Strength of Materials, and Physics in a small Mid-western College. Must have Master of Science Degree, preferably in Engineering or Physics. Salary dependent on qualifications and experience. Position permanent. Address inquiries to Box 291, Institute of the Aeronautical Sciences.

Development Engineer—Major rubber company has opening for man with good technical education in mechanical or aeronautical engineering. He will work on new products, follow technical phases of manufacture, and specialize in aeroplane tires and products. Some previous experience desired but not necessary. In reply furnish full information, covering education, experience, also age and salary expected. Address inquiries to Box 287, Institute of the Aeronautical Sciences.

Engineers—Aeronautical, Mechanical Electronic Designers, Draftsmen, Checkers; Wide variety of interesting work on essential projects. Excellent postwar opportunities. Manhattan location; W.M.C. rules observed. Address inquiries to Box 284, Institute of the Aeronautical Sciences.

Draftsmen—Four or five, wanted by large research and development organization; experienced in the layout of aircraft structural members. Four or five years' experience required; knowledge of stress analysis desired. Experience in wing or fuselage group would prove satisfactory. Address inquiries to Box 282, Institute of the Aeronautical Sciences.

Aerodynamics Engineer—Practical experience wanted by well-known long-established mid-west manufacturer to conduct technical research and market development in ventilating and air-cooling division. Attractive salary for man of ability and ambition. Address inquiries to Box 275, Institute of the Aeronautical Sciences.

Mechanical, Chemical or Metallurgical Engineer, experienced in fabricating and bonding aluminum alloys, to function as project engineer in conversion of copper exchange heat devices to all aluminum construction for aircraft applications. Mid-west location, position permanent. Salary commensurate with experience and ability. Address inquiries to Box 271, Institute of the Aeronautical Sciences.

Contact Man—to aircraft industry, travel mid-west and east representing manufacturer of heat transfer equipment. Engineering and previous contact with aircraft industry desirable but not essential. State background and previous employers and enclose photo. Address inquiries to Box 266, Institute of the Aeronautical Sciences.

Aero & Mechanical Engineers—Large engineering firm engaged in military work with growing backlog of postwar jobs needs engineering personnel in all categories: Designers, Layout & Detail Draftsmen, Stress Analysts, Checkers, etc. Location Manhattan. W.M.C. rules observed. Address inquiries to Box 263, Institute of the Aeronautical Sciences.

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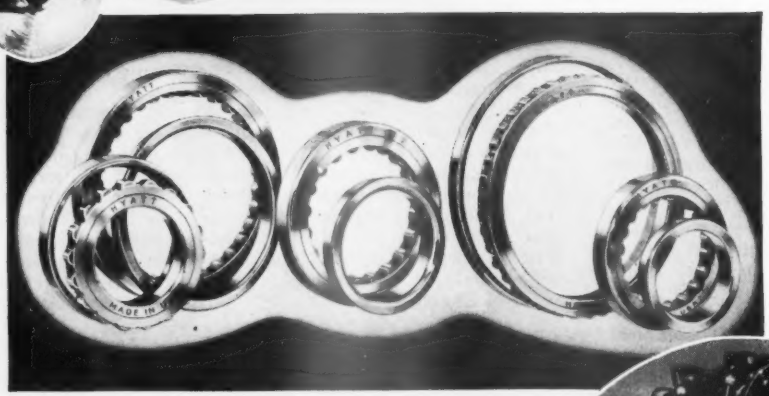

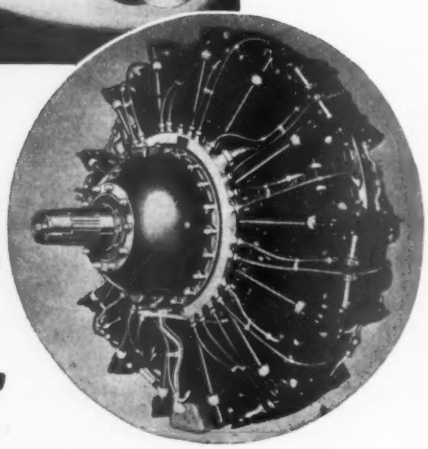

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Engineer—Registered university graduate and professional aeronautical engineer. Ten years' experience in the aviation industry including airplane design, stress analysis and structures, aerodynamics and Director of sales, engineering and production in aircraft accessories field. Desires to make permanent connection as executive, design engineer, sales engineer, or technical representative in the aviation industry, or as an aviation manager or technical adviser in nonaviation industry. W.M.C. will be complied with. Address inquiries to Box 289, Institute of the Aeronautical Sciences.

Industrial Designer—Age 34, family, engineering background, executive experience, has six years' experience in industrial design (product development and interiors) of which two years were spent in aviation. Qualified to do market investigation for reconversion or to act as liaison between management and designers, also as staff industrial designer. Change contemplated because last assignment which was the redesign of a series of aircraft engine-test equipment is completed. Available now. Can comply with W.M.C. regulations. Address inquiries to Box 288, Institute of the Aeronautical Sciences.

Aeronautical Economics Research Worker—College Graduate, Economics Major, 5 years employed in Aircraft. Now working for Masters' Degree in Economics at N.Y.U. and employed in Aircraft. Desires connection with research staff involving Economics in Aeronautics. Address inquiries to Box 286, Institute of the Aeronautical Sciences.

Engineer—B.M.E., 1943. Nine months assistant project engineer on electromechanical aircraft devices. Honorably discharged from the U.S. Navy. Desires research or development position in New York City. Address inquiries to Box 285, Institute of the Aeronautical Sciences.

Engineering Test Pilot—Ten years' flying experience, Army trained, three years of experimental test flying with prominent manufacturer of multi- and single-engined military airplanes. B.S.-M.E. degree, majored in Aeronautical Engineering. Proven executive ability. Desires to change company affiliation. West Coast preferred. Address inquiries to Box 279, Institute of the Aeronautical Sciences.

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Aeronautical Engineer—Responsible for the development of several successful aircraft, desires additional design or supervision work under contract. Address inquiries to Box 273, Institute of the Aeronautical Sciences.

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Aeronautical Engineer and Pilot—B.S. and M.S.E., Commercial Pilot, three years' experience in flight-test work involving handling characteristics of a variety of airplanes. Can get full release for position that involves flying. Would prefer position where engineering and flying can both be used. Address inquiries to Box 270, Institute of the Aeronautical Sciences.

Power Plant Development Engineer—Six years' experience in research, design, and development. Familiar with the aerodynamic, thermodynamic, and metallurgical aspects of gas turbine development. Address inquiries to Box 267, Institute of the Aeronautical Sciences.

Electrical Engineer—Graduate, age 30, family. Eight years' experience leading aircraft companies in design and research on electrical, radio and instrument components. Five years as a section head in the above capacities. Thoroughly familiar with related aircraft engineering problems. Desires responsible position having good postwar possibilities. Prefers vicinity of Los Angeles, South America, or other suitable location will be considered. Address inquiries to Box 259, Institute of the Aeronautical Sciences.

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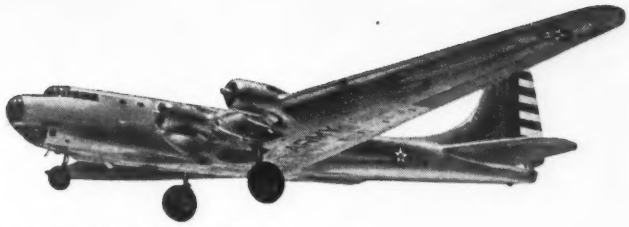

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Rotors are made in segments instead of a continuous ring; this allows for heat expansion without warping or cracking.

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Periodicals

Accessories and Equipment

Design of Hydraulic Systems. Parts I and II. Howard Field, Jr. The first and second articles of a series contain an analysis of the various components of a hydraulic system.

The first article deals with pumps and their application. Centrifugal, gear, vane, and piston pumps are described, and an analysis is made of their characteristics, advantages, and limitations. The control of the output of pumps suitable for hydraulic systems is discussed.

The subject of the second article is packings and their applications. Consideration is given to packing materials, the types of packing available, the purpose of the seal, and installation problems. The advantages and disadvantages of the different types of packing are discussed. *Product Engineering*, January, 1945, pages 22–26, 4 illus.; February, 1945, pages 100–104, 5 illus.

Cargo Plane Flooring. Harry S. Pack. A description is given of tests and research work conducted with the object of obtaining a more durable flooring for cargo planes. An analysis is made of various floor materials and flooring designs. Factors that must be considered in the development of a serviceable floor of light weight are listed. Details of the floor design are discussed. *Industrial Aviation*, February, 1945, pages 40, 42–44, 9 illus.

Aerodynamics

Note on the Elliptic Wing. F. Steinhardt. Reference is made to Prandtl's acceleration potential method for studying the aerodynamics of a lifting surface and to elaborations of the theory for wings with circular and elliptic plan view carried out by W. Kinner and K. Krienes. In an effort to extend the class of wings for which numerical results have been obtained, a theory based on the work of Krienes was developed for the semi-elliptic wing by E. R. Lorch. Computations carried out for this case by the writer had to be abandoned because of very poor convergence. This suggested that the questions of convergence in Krienes' work, which plays an important role there, be examined more closely. The results of the investigation are presented. *Quarterly of Applied Mathematics*, January, 1945, pages 346, 347.

Calculation of Span Lift Distribution. Part II. Max M. Munk. The second of a series of articles contains a table of multipliers for the span lift distribution computation. The table embraces ten semispan stations instead of five. Instructions are given for the computation of the down-wash angle and for the use of the table in calculating the elliptic span distribution. It is stated that the table also gives the theoretically correct down-wash distribution for any lift distribution. A subsequent article in the series will present a sample computation of the lift distribution when the chord and the incidence distribution are given. *Aero Digest*, February 1, 1945, page 84.

Power Series Expansions of the Velocity Potential in Compressible Flow. G. K. Batchelor. It is noted that many attempts have been made to solve analytically the equation describing the two-dimensional irrotational flow of a compressible fluid but none has met with complete success. It is explained that most of the progress has been through some linearizing process. In this paper use is made of an expansion of φ (the velocity potential) as a power series in r^{-1} (where r and θ are polar coordinates), and it is shown that the equation for each of the coefficients in the series is linear. Some light is thrown on the form of the expression for φ which may be expected in two cases of zero and finite circulation about the obstacle. *Quarterly of Applied Mathematics*, January, 1945, pages 318–328, 2 illus.

Air Cargo

A Basis for Air Cargo Rates. Part IV. John H. Frederick. This is a continuation of an article discussing the costs of operation on which air-cargo rates may be based. It is emphasized that air-cargo services will have to be sold on the basis of value to the shipper and receiver. Basic factors of major importance in determining whether a shipper will use air-cargo transport for a particular shipment are stated to be the value per pound; perishability and fragility; and the value of the service, including style, obsolescence, etc. Consideration is given to the need for speed in shipping, the shipment of perishable products, shipping rates for specialty items, and the expansion of air-line services as a means of fostering growth in the volume of air-cargo traffic. *Distribution and Warehousing*, February, 1945, pages 58–60, 111.

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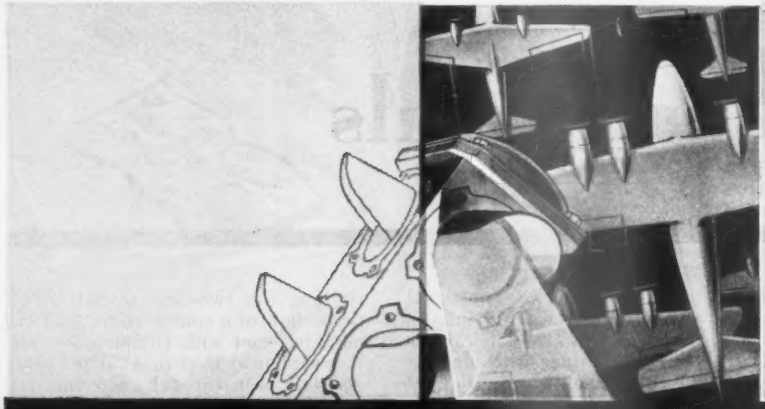

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"Flight 232 calling airport, come in airport. Over".

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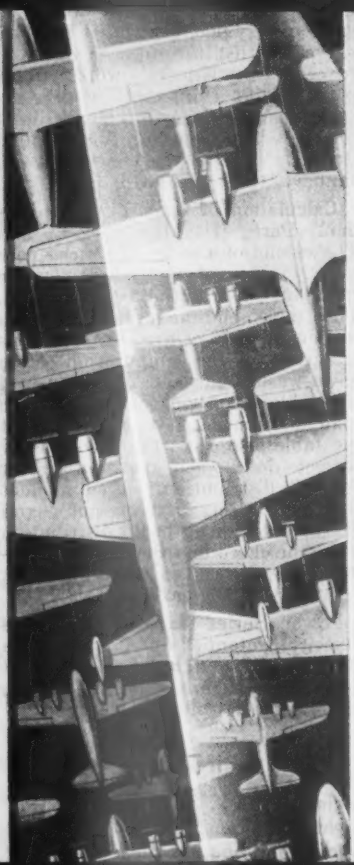

Not much different from the way planes come into the major airports right now, is it?

But tomorrow the traffic will be greater than ever. More traffic in the air will require accurate ground and aerial traffic control, to carry instructions from ground to air to ground.

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We Need an Air-Shipping Clinic. Thomas Wolfe. The progress made in packaging is reviewed and the problems involved in this important phase of air transportation are outlined. Present and possible future applications of new materials for containers are considered. The use of fiber, plywood, paper, and aluminum for containers is discussed. Problems involved in the shipment of perishables are also considered. The writer suggests the establishment of a shipping clinic to develop reductions in space-waste and weight. *Air Transportation*, January, 1945, pages 7, 8, 10–12, 2 illus.

Civil Glider Trains. The possibilities of large-scale employment of glider trains for civil air transport are viewed with pessimism. The advantage of increased pay load offered by glider trains is shown to be offset by many disadvantages, chiefly reduced cruising speed and high operational costs. As an exception, it is stated that the operation of glider trains may be justified under such specific conditions as the absence of landing fields. *Flight*, January 11, 1945, pages 44, 45, 1 illus.

"Look Out Below!" John L. Kent. This is an account of how supplies are dropped from airplanes to Allied forces in the Pacific theaters of war without the use of parachutes. Methods of packaging the supplies are noted, as well as techniques of preparing the package for dropping, "spotting" the place where the package is to be dropped, and "kicking" the package out of the plane. *Flying Aces*, March, 1945, page 20, 4 illus.

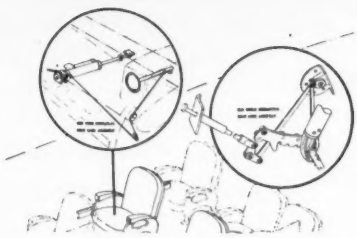
Air Law

The Legal Basis of Medical Safety in Aviation. Thomas H. Sutherland. A discussion of the legal and medical aspects of regulations governing the use of aircraft, the responsibility of pilots and owners of aircraft in private and commercial flying, and the duties of medical examiners in passing upon the physical qualifications of applicants for pilot certificates. Laws, cases, and precedents are cited with respect to the many legal and medical ramifications involved in regulating the use of aircraft and in determining the physical fitness of men and women to operate aircraft. *The Journal of Aviation Medicine*, December, 1944, pages 360–365.

Should California Extend the Economic Regulation of Intra-State Air Transportation? Thomas Hart Kennedy. This article deals with the proposed California Air Commerce Act to extend the authority of the California Railroad Commission to provide complete economic regulation of intrastate air transportation. It outlines the history of such regulatory law, considers "the public convenience and necessity" for the legislation, relates the important provisions of the proposal, and offers the writer's views regarding its enactment. His opinion is that passage of the bill would impede air development in California and restrict the number of jobs available for airmen and aircraft workers after the war. He suggests that the California Legislature may contribute to the advancement of aviation by repealing Section 5a of the California Air Navigation Act, permitting all comers, without applying to anyone, to carry passengers and cargo for hire anywhere they choose in California, providing they conform to Federal standards of safety. *Western Flying*, February, 1945, pages 38, 39, 82, 84.

Air Power

Has Air Power Met the Test? Alexander Kiralfy. In an analysis of the contributions made by air power toward shortening the war, the results of the following are indicated: Allied defensive air action, air action in support of ground troops and as part of amphibious operations, and strategic bombing. While he stresses the effectiveness of air power, the writer also takes into account measures that can be and have been taken to counteract the consequences of strategic bombing. His conclusion is that bombing shortens wars but does not necessarily guarantee short wars. *Flying Aces*, March, 1945, pages 18, 19, 61–63, 5 illus.



The above illustrations show (*top*) the new Douglas Aircraft Company lightweight passenger seat, and (*bottom*) drawings indicating the principal differences between the old- and new-style seat lock assembly. The chair reduces the weight per 21-passenger plane by 147 lbs. and costs but slightly more than half the price of the old-type passenger chair.

Air-Warfare Review. Hanson W. Baldwin. This one of a series of monthly analyses is devoted to an interpretation of air-war events and patterns in the Pacific. Expounding the theory that more intense bombing of Japan requires acquisition of island bases closer to the target and explaining why imminent acquisition of continental bases by the Allies seems improbable, he indicates five likely areas from which Japan can be bombed. The writer also offers the opinion that the mounting air war, although a very vital factor, cannot bring about a decisive victory over Japan without actual amphibious landings on the main Japanese islands. High-priority objectives in Japan are named; the difficulties that may be placed in the way of the Superfortresses by a new type of Japanese fighter are noted; and the possible future need of fighter protection for Allied bombers is considered. *Skyways*, March, 1945, pages 17, 76, 1 illus.

The Struggle of the 14th Air Force. Beryl D. Kneen. Some notes on the operations, problems, and record of the U.S. 14th Air Force. In this report it is claimed that the operations of the 14th are practically the only deterrent to Japanese ground advances. The results of the 14th's air action from July, 1942, to October 31, 1944, in terms of Japanese shipping, planes, and other losses are shown by means of a chart. *Flying Aces*, March, 1945, pages 22, 23, 59, 5 illus.

Air Transport

Recommendations for the Reduction of Airline Costs. Joseph L. Nicholson. Reviewing potential sources of competition that indicate the necessity for air lines to lower their operating expenses and costs, the writer offers some advice on how a reduction of ground and indirect expenses may be effected. He advocates the elimination of unprofitable stops and routes producing small revenue, showing that attempts to furnish airline service to sparsely populated and closely located areas result in four major difficulties: the establishment of new cost levels as a result of additional investment in facilities; a decrease in traffic density or the revenue ton-miles per route mile; loss of the speed benefit through numerous stops; and disadvantageous competition with the more frequent schedules of surface transportation where speed is not of paramount importance. The suggestion is made that integration with surface transportation offers a possibility of lowering operating costs which should not be neglected. The writer's opinion is that air transportation could expand more rapidly if profits were limited by competition only rather than by Governmental regulation. *Aero Digest*, February 15, 1945, pages 47–49, 1 illus.

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Airplane Descriptions

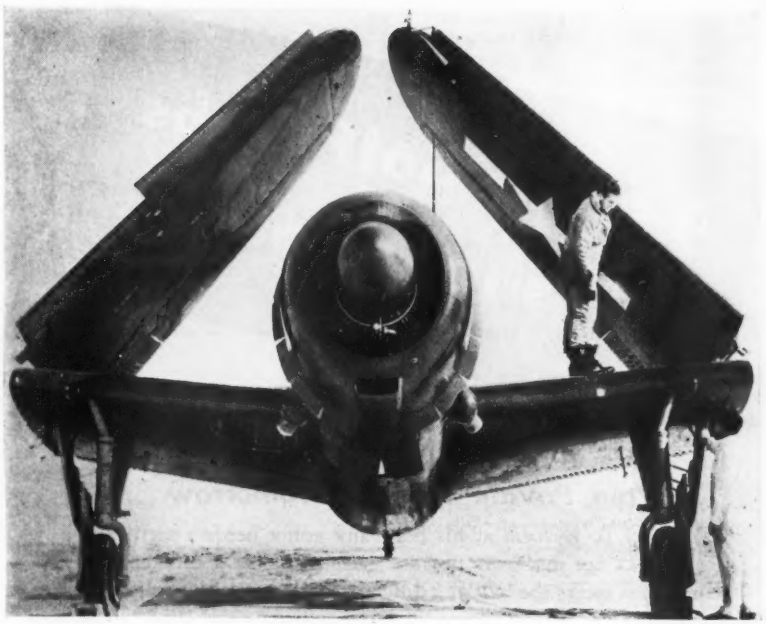
Enemy Warplanes. A compendium of Japanese and German military aircraft. Accompanied by descriptive data, photographs show conventional and jet-propelled fighters, various types of bombers, marine aircraft, transports, and gliders. *Skyways*, March, 1945, pages 42–53, 39 illus.

Old But Not Obsolete. L. Graham Davies. This article reports on the resumption of work in the building of the Latécoère 631 flying boat, which was designed in 1937 for transatlantic service. It is stated that many ideas incorporated in the design were well in advance of their period and that the craft should prove to be a very serviceable air liner. The specifications of the six-engined passenger aircraft are given, as well as a description of the luxurious accommodations provided. Features of design noted are that the pay load is carried on one deck, with a small upper deck for the pilots and crew, and that the hull is designed with particular regard for reducing water friction. The illustrations show views of the passenger quarters and drawings of the interior layout. *The Aeroplane*, January 26, 1945, pages 114, 115, 7 illus.

Hughes' First Transport Plane Will Be 18-Passenger "Feederliner." Scholer Bangs. Advance information and specifications are given about an 18-passenger feeder air liner that the Hughes Aircraft Company will produce. Designated by the company as "Project 16," this aircraft will have a stalling speed of 57.5 m.p.h. It will be a high-wing two-engine monoplane designed for a gross weight of 18,500 lbs., with a 6,000-lb. useful load. Performance specifications call for a top speed of 237 m.p.h. and a cruising speed of 186 m.p.h. with 60 per cent load at 5,000 ft. The plane will be powered by two Pratt & Whitney Twin Wasp engines with a take-off rating of 825 hp. Features of the plane include an unusually wide fuselage, permitting the installation of seats four abreast with an aisle between and fuel tanks that will permit under-wing loading for quick servicing. *Aviation News*, February 19, 1945, pages 7, 8, 2 illus.

Fighters of the Third Reich. H. J. A. Wilson. A review of developments in the design of fighter aircraft built for the German air force during the last 12 years. Particular attention is given to early developmental activities. *The Aeroplane Spotter*, January 25, 1945, pages 18, 19, 10 illus.

De Havilland Mosquito XVI. Some brief details are given about the Mosquito XVI. It is revealed that this model of the Mosquito is designed to operate at altitudes of 36,000 ft.; that long-range drop-tanks, which are interchangeable with bombs, give it a range in excess of 1,500 miles; and that the starboard engine is a Merlin 72 and the port engine a Merlin 73, each of which develops over 1,650 b.hp. *Flight*, January 4, 1945, pages 8, 9, 5 illus.



The Curtiss SB2C-4, newest version of the Navy's SB2C Helldiver. Besides the 20-mm. wing cannon, the plane carries eight 5-in. rockets mounted under the wing and wing bomb racks that will carry a 1,000-lb. load in addition to the unrevealed internal bomb capacity (known to be more than 1,000 lbs.). Better dive braking is permitted by new perforated flaps at the trailing edge of the wing. The arresting hook for carrier landings is carried extended, rather than retracted.

Warplanes of the United States. A tabulation of statistical data about warplanes currently in use by the armed forces of the United States is preceded by some information about the outstanding aeronautical engineering developments achieved in 1944. Figures are reported also regarding the production rates attained during the past 5 years on various types of warplanes in both the United States and Great Britain. The tables list the dimensions, weights, engine and performance figures, designer-manufacturer, and Army or Navy designation of each plane. *Aero Digest*, February 1, 1945, pages 71–73, 6 illus.

Airports and Airfields

Airport Merchandising. Dudley M. Steele. The sale of aviation petroleum products is discussed in the second of a series of articles investigating individual revenue-producing schemes for airports. Advice is given about the arrangement to be made with oil and gasoline companies, the storage of the items, charges and discounts to customers, and the amortization of equipment. The operator is cautioned on two fundamental points: (1) that the airport definitely control the sale of all aviation petroleum products sold at its terminal, except to the air lines where provisions of their leases do not permit; (2) in the case of large airports, that exclusive agreements with any one oil company be avoided. *Southern Flight*, February, 1945, pages 55, 58.

The Class 1 Airport—a Blueprint. Part I. First of a series of articles analyzing the facilities, operation, maintenance, personnel requirements, revenues and expenses, and distinguishing characteristics of the various classes of airports. In this section the Class 1 airport is considered in detail, with the Municipal Airport at Marshall, Minn., typifying landing fields falling into the classification of "fields for private aircraft having one or more landing strips between 1,800 and 2,700 ft. long and 300 ft. wide, with drainage, fencing and marking facilities, and—if used for night flying—beacon, boundary, obstruction, and runway lights." *Airports*, February, 1945, pages 27–31, 9 illus.

Airports for the West. Part VI. The sixth article in a series investigating the requirements for postwar airport facilities in the western part of the United States and discussing some of the problems involved in the establishment of those facilities. Article six is concerned with airparks. It indicates the value of airparks in stimulating personal flying and describes the planned functions of the airparks, the flight operations that will or will not be conducted there, and the facilities they will encompass.

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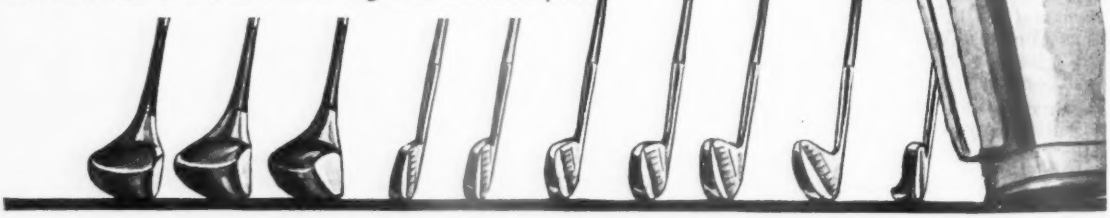

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The physical aspects of postwar airparks, types and numbers of runways, runway surfaces, landscaping, and storage provisions are among the factors considered. *Western Flying*, February, 1945, pages 54, 88, 1 illus.

Airport Maintenance. Part II. The second of several articles on the various phases of airport maintenance is concerned with the problems of turf maintenance. It offers specific suggestions on how to plant, cultivate, and perpetuate satisfactory turf for airport areas. *Southern Flight*, February, 1945, pages 52, 54, 4 illus.

Forty-Eight Instrument Landings an Hour. J. D. Henry. An American Airlines pilot suggests revisions in the approach to the problem of traffic control. He states that an appreciable increase in the schedules that can be handled during instrument conditions can be accomplished by the use of multiple parallel runways, unlimited radio facilities, dual airways, and the discarding of the practice of landing into the wind. He discusses present traffic-control techniques and lists five factors of safety. *American Aviation*, February 1, 1945, pages 68, 70, 72, 1 illus.

City Hall Control of Municipal Airports. John H. Frederick. Based on a recent survey of the larger cities of the United States, seven different methods of municipal airport control are noted. These provide for supervision under the Port Authority; Department of Public Works; Department of Parks; Department of Public Utilities; Department of Finance; Department of Public Service; and County and City Commission. The relative merits of the different systems are discussed, with emphasis placed on the need for efficient business procedures under any system. It is also stated that municipalities should retain control and operation of their airport facilities only if they are willing to engage the services of an experienced airport manager who would be entrusted with full control of expenditures on an annual budget basis and who would be completely free from political domination. *Southern Flight*, February, 1945, page 51.

Building the Small Airport. Part III. Robert G. Blatt. This is the third of a series of articles about the construction of small airports. The writer discusses the clearing of obstructions from approach and turning zones, grading, permissible gradients and grading materials, and the construction of evacuation backslopes. Drawings and photographs clarify the explanations. *Aviation Maintenance*, February, 1945, pages 50–53, 100, 102, 12 illus.

Radio and the Small Airport. Sydney Nesbitt. Citing the advantages of a radio traffic control tower for the small airport, the writer indicates what equipment is necessary and the probable cost of such equipment immediately after the war. He also mentions some of the problems attendant upon obtaining a license for control-tower transmission. Advantages of installing present low-frequency transmitters are weighed against those of installing now the VHF equipment that will eventually be in exclusive use. *Airports*, February, 1945, pages 40, 41, 46, 3 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

"Fine To-Day–Rain To-Morrow." This is a brief article about the huge program of airfield construction undertaken in India after the entry of Japan into the war. It is stated that only after the war is over will the curtain be lifted to disclose the full picture of this program. Because India is not a fully mechanized country it was necessary to employ vast masses of labor, 600,000 Indian laborers being employed at the peak of the construction period. *Indian Aviation*, October, 1944, pages 238, 239, 1 illus.

Night Landing. Charles F. Banfe. Suggested as a possibility for United States airports, this is a description of a night landing system employed in Europe. It is based upon the use of two groups of illumination—a series of outside lights by which the pilot identifies the field and a series of inside lights that guide him to and along the proper runway. *Air News*, February, 1945, pages 28, 72, 74, 1 illus.

Evaluating Airport Costs in Dollars and Sense. Raymond Nathan. This article contains some general figures on the costs of building small airports. It also suggests the sources to which an operator can look for revenues to cover operating expenses and possible amortization of the original investment. In reviewing methods of increasing airport revenue, the three principal income-producers are stated to be hangar and storage charges, sale of gasoline and oil, and rental of office space. *Southern Flight*, February, 1945, page 50.

Watch Out for Weeds! From experience with one airport which had a prolific weed growth, advice is given on methods and equipment for keeping airport turf free from weeds. It is stated that weed growth can be checked to some extent by selection of weed-free topsoil, cutting in time prior to seeding, selection of good quality seed and plant material, and proper and timely mowing after the grasses emerge from the soil and begin to develop turf. *Airports*, February, 1945, pages 38, 39, 46, 5 illus.

The Royal Engineers Construct an All-Weather Airstrip in Brick. Roger Montgomery and Charles Brown. A description is given of how Royal Engineers are building air strips to keep the British 2nd Tactical Air Force flying. The article describes and illustrates what was seen by an air-war correspondent and a photographer during a visit to the Western Front. *Aeronautics*, February, 1945, pages 32–36, 15 illus.

Waterways Shape Airport Planning. Proposals for postwar airports to be located in Beaver County, Pa., are summarized. The utilization of existing waterways as landing fields is included in the recommendations. Expenditures amounting to $111,470,180 are contemplated. *Aero Digest*, February 15, 1945, page 96, 1 illus.

Maintenance of Airport Lights. Part I. J. S. Haney. First part of a continued article advising about inspection, servicing, and repair procedures for airport lighting systems. This initial installment is concerned with specific suggestions about lighting circuits; series lamps; use of paint; rotating beacon; beacon lamp changer; code beacon and flasher; cone-mounted lights and obstruction lights; wind-cone fixture; wind tee; field and hangar floodlights and ceiling projectors. Since the stocking of all spare parts that may normally be needed for replacements is considered a part of periodic maintenance, a list of items for stocking is suggested, based on percentages of installed equipment. *Southern Flight*, February, 1945, pages 43–45, 7 illus.

Armament

U. S. and British Gunsights. This article contains some particulars about the design, construction, and operation of two electronic computing gun sights. One is the K-8 gun sight manufactured by the Fairchild Camera and Instrument Corporation; the other, the Mark 11-D gun sight developed by the British at the Ministry of Aircraft Production Experimental Establishment. *Aero Digest*, February 1, 1945, pages 110, 146, 3 illus.

New Aircraft Rockets Effective Aid to Fighters and Bombers. A commentary gives particulars about an improved type of aircraft rocket and launcher that was developed primarily for the Navy but is stated to have been used with great success by the Army Air Forces. Important features of this 5-in. high-velocity weapon are described. Because of the lack of recoil the flight of an airplane is not appreciably affected by the firing of successive rounds of rocket ammunition. *Aviation News*, February 12, 1945, page 27.

Avigation

Finding the Navigational Stars. Part II. Ben C. Kenny. The second of two articles about the identification

of the more common stars used in celestial navigation describes two additional portions of the sky as seen during nights in February, 1945. One is the group outlined by the stars Aldabaran and Capella and the planet Saturn, the other is a group marked by Sirius, Canopus, and Adhara. The positions of other bodies in these regions is explained and information given to help students in learning to identify them. The illustrations comprise night photographs of the sky regions studied, with diagrams showing the names and locations of the prominent stars mentioned. *Aero Digest*, February 15, 1945, pages 68, 69, 196, 4 illus.

Bearings

Efficiency of Needle Bearings in Aircraft Control Pulleys. E. K. Brown. The development of needle bearings to replace ball bearings in the pulleys used in aircraft control systems is recounted in an explanation of the application of that type of bearing. The pulleys were made to conform to Specification AN-FF-P-796 and to be interchangeable with pulleys equipped with ball bearings. The article describes the construction and use of single-row and double-row needle bearings, and the tests to which they were subjected in establishing their conformance with the specifications and their frictional resistance. *Aero Digest*, February 1, 1945, pages 106, 107, 149, 5 illus.

Civil Aviation

We Zip for Business. R. B. Kenty. An account of how a parts-and-servicing company utilizes a light plane for its sales operations. Advantages of this sales aid are outlined. A report is made of the amount of mileage covered and the weather conditions encountered, and an analysis is given of the costs of maintaining the plane over a 16-month period. *Southern Flight*, February, 1945, pages 29, 30, 1 illus.

Post-War Civil Aviation in India. Parts I to IV inclusive. Sir Frederick Tymms. The address by the Director of Civil Aviation in India, read before the Institution of Engineers (India) at New Delhi on July 7, 1944, is presented in a serial article of four parts. A review is given at considerable length of the progress of civil aviation from the inauguration of the Department of Civil Aviation in 1926, as the successor to the former Indian Air Board. The study encompasses the work of the department in the many phases of its activities in regulating and encouraging commercial and private air transportation, giving statistics and figures for the scheduled air routes, airports, costs of facilities and services, types of aircraft used, and other information. The paper offers a comprehensive plan for the development of air transportation after the war, outlining the commercial routes, estimating the costs and revenues, and suggesting plans for regulating traffic and licensing the aircraft and personnel. The fourth part deals especially with training and private flying and closes with brief comments about the outlook for the manufacture of aircraft in India. *Indian Aviation*, July, 1944, pages 172, 174–176; August, 1944, pages 188–190, 192, 193, 1 illus.; September, 1944, pages 206, 208, 210, 211; October, 1944, pages 224–226, 228.

I Learned to Fly Again! Based on his experiences in receiving refresher instruction at 22 schools in twelve cities over a period of 14 months, the writer indicates specific faults of current civilian flight-training schools. He claims that civilian flight instruction is in dire need of modernization because during the period of their war service the operators and their employees have forgotten how to handle the civilian as an individual. The importance of personalized treatment of students and the fact that in peacetime they must again "sell" their product or service to the public, are stressed. *Southern Flight*, February, 1945, pages 32, 38.

A Plan for British Civil Aviation. Part I. Colin Richardson. Beginning of a two-part article urging the immediate inception of a civil aviation program for Britain and outlining primary features of such a program.

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Part I is concerned with the requirements for civil aviation personnel and aircraft. For personnel, a state-subsidized training center is suggested, at which the instruction would be divided into five classifications: administration, traffic, operations, air crews, and engineering. For aircraft, requirements are specified as to the types that will be needed, the purposes for which they will be needed, engine design, undercarriage design, pressurization, and fuel needs. The point is stressed that British air lines must use British aircraft and not American. With this in view, it is suggested that the British aircraft industry should proceed immediately with designing aircraft for civil transport and gradually transfer one-tenth of its facilities to this work. *The Aeroplane*, January 26, 1945, pages 109–111, 2 illus.

Companies

"They Believe in Canada." These notes on Leavens Bros. Limited tell something about the past activities of this company as well as about its future plans for training, air transport, and aircraft distribution operations. The company is credited with having been the only "small operator" entrusted with the operation of a full-sized Air Observer school by the Royal Canadian Air Force. *Canadian Aviation*, February, 1945, pages 66, 67, 118, 11 illus.

Hindustan Aircraft, Ltd. George Stromme. An article on the operations and record of an Indian aircraft-manufacturing company. The major part of the article is devoted to a discussion of industrial-relations problems peculiar to India and the solutions that the company has evolved for them. Comments are included about the organization and history of Hindustan Aircraft, Ltd., the directors and executives, personnel, training program, the physical setup of the factory, and the types of planes that have been produced. *Western Flying*, February, 1945, pages 46, 47, 86, 88.

Control Equipment

Basic Principles of Power Boost Flight Controls. E. G. Riley. To demonstrate the need for power-boost controls, the practical limitations experienced with mechanical types of manual-assist control methods are briefly described. An analysis is then made of power-boost control in general, insofar as the location of major elements is concerned. The writer also discusses the conditions under which power boost is required. The basic characteristics that are essential as a design nucleus are listed. A complete description of the principles of operation of the Vickers hydraulic boost control as used on the Martin Mars is presented. A schematic diagram shows a typical control system incorporated in the boost unit. The selection of the power source and related hydraulic and mechanical equipment required for the satisfactory operation of the Vickers unit is discussed. How each basic design characteristic can be fulfilled by this type of hydraulic boost control is explained in a summary. *SAE Journal*, February, 1945, pages 110–114 (Transactions), 4 illus.

Remote Indicating Equipment Design. Col. T. B. Holliday. In this article applications of remote indicators are summarized and the various steps involved in the problems of delivering a remote indication are discussed. Attention is given to the hydraulic, pneumatic, and electrical methods of transmitting a signal. Operating conditions are considered with particular reference to factors that will cause errors in indication. Methods of transmitting a pressure signal electrically are outlined. The indication of temperature conditions is discussed and brief mention is made of problems involved in the indication of rotary speed. *Industrial Aviation*, February, 1945, pages 7, 8, 10–12, 99, 12 illus.

Design

Monocoques. Parts I and II. Maurice F. Allward. Two articles review the principles and development of monocoque fuselages. In the first, some of the major problems involved in stressed-skin construction are investigated and different arrangements of stringers and formers are discussed. The history of early wooden monocoque construction is traced briefly. Monocoque variations are demonstrated in the features of individual British, German, and United States airplanes. As an example of the procedure adopted for the testing of large monocoque-structure aircraft, the structural testing system used by the Boeing Aircraft Company is described.

In the second article, the features of several different monocoque planes are surveyed. These are the British Bristol Beaufighter, Hawker Typhoon, Avro York, and de Havilland Mosquito; the Japanese Hap; and the German Messerschmitt line of fighters and the Ju 88 series. The article ends with comments on the revival of wooden construction as exemplified in the Mosquito. *Flight*, January 18, 1945, pages 65–69, 9 illus.; January 25, 1945, pages 94–97, 7 illus.

Structural Details of the Army's CG-4A Glider. Cutaway drawings of various components and general data about its design supplement this engineering analysis of the Waco military glider. Attention is called particularly to the welded steel-tube fuselage, the attachment of the tail wheel oleo, dual flight controls, and rigging of control cables. *Aero Digest*, February 1, 1945, pages 78–83, 12 illus.

One or Two Engines? Lt. H. Piper. The feasibility of dual-engined aircraft for private flying is discussed. Noting the dangers of engine failure in a single-engined plane, the writer indicates the advantages of two engines for personal airplanes. He also analyzes what the additional safety and sense of security would cost in terms of greater original cost, cost of maintenance and operation, performance, and ease of flying. *Air Facts*, March, 1945, pages 28–31.

Control of a Multi-Engine Airplane with Unsymmetrical Power. Leonard M. Greene. This is a discussion of controllability factors accompanying sudden failure of one engine of a twin-engined airplane. Consideration is given to the moments caused by unsymmetric power, which include various rolling and yawing moments, and to the determination of the equilibrium speed with this condition. Various changes are recommended to meet the condition where controllability with unsymmetric power is a critical feature in multiengine airplane design. *Industrial Aviation*, February, 1945, pages 58, 59, 3 illus.

Simplified Numerical Integration for Design Engineers. Part II. G. L. Shue. The concluding section of a two-part article carries out a detailed description of the difference-table method for solving higher-order equations in aircraft design. Several tables must be worked concurrently, the number of tables depending upon the order of the differential equation, and each table complements the other as the example proceeds. A typical aircraft-engineering problem involving a heat-transfer design equation is solved by the use of the tables, each step being explained. Another example from a study of compressibility is worked out in a similar manner. The tables are reproduced. *Aviation*, February, 1945, pages 208–211, 2 illus.

Boosting "Flying Fortress" Bomb Loads. J. P. Butler and David T. Marvel. A study of the methods and load factors by which the bomb load of the B-17 was increased to over 6 tons and the overall gross weight to more than 30 tons although the basic design of the aircraft remained the same as originally produced in 1934. One of the main factors credited with making possible the doubling of the plane's gross take-off weight is the stressed-skin and spar type of wing construction in which the distribution of loads is approximately even throughout the structure. Details are given on how the special-type spar chords are fabricated. *Aero Digest*, February 1, 1945, pages 100, 101, 130, 3 illus.

Asymmetry Again. Roger Tennant. An asymmetric design for a long-range fighter is suggested, with reasons given why this arrangement is con-

Lower Sound-Level Cyclones for Increased Passenger Comfort

Smooth, quiet flight, which builds appreciation for air travel, is possible in two ways. One is to blanket noise with soundproofing, a method costly in weight. The other is to eliminate noise at its source.

Lower reduction gear ratios on Cyclones have long helped cut propeller noise. Now, coupled with the new Wright turbo-supercharger, Cyclones bring sound levels still lower by decreasing exhaust noise. Added comfort from lowered sound levels is important to all passengers and air crews. It is comfort which will do much to bring about greater public acceptance of travel by air.

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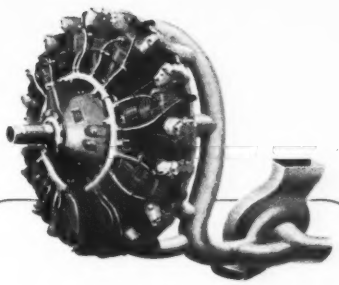

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sidered the most efficient for the purpose. The proposed design offers a combination of a nacelle and pusher propeller together with a tractor propeller and fuselage. It is claimed that this arrangement has the following advantages: best possible concentration and balance of weight; reduction of yawing couple when cruising on one engine; no shaft drive required, except a short extension on the pusher; no interruption of the airflow over the wings when cruising on the pusher engine only; minimum wetted area and structure weight; elimination of turbulent flow from short nacelles. Specifications for the suggested fighter plane are listed and an illustration of the model is shown. *Flight*, January 11, 1945, pages 34, 35, 3 illus.

Design Factors of Civil Aircraft Affecting the Operating Cost. R. K. Pierson. Reference is made to the important role the designer can play in improving the economic efficiency of air transport. Some calculations illustrating this aspect of aircraft design are reviewed. The writer first discusses the basis for cost estimation and then sets forth estimated costs for a typical aircraft. *The Journal of The Royal Aeronautical Society*, January, 1945, pages 26–34, 13 illus.

Toward a Better Lightplane. Stanford J. Stelle. To indicate the strong and weak points of prewar light-plane design, a résumé is given of the most prominent difficulties encountered in the maintenance of light planes during the C.A.A. war training program. The report is divided into a survey of the problems encountered with the following specific components: propellers and propeller hubs, engine mounts, cowlings, fire wall, cockpit, fuselage, control surfaces, fabric, gasoline systems, landing gear, and engines including crankshaft, valves, cylinder heads, crankcases, spark plugs, breathers, and miscellaneous. *Flying*, March, 1945, pages 53, 54, 78, 80, 84, 5 illus.

Taylorcraft's Liaison Planes—the L-2 Series. Part I. First part of a continued article analyzing the design features of the Taylorcraft L-2 series aircraft. Illustrated by schematic drawings, the details in Part I include those of wing and tail assemblies, landing gear, power-plant controls, fuel-system instruments, and elevator-control system. They are supplemented by a brief general description of the Models L-2, L-2A, L-2B, and L-2M, and their purposes and differences. *Aero Digest*, February 15, 1945, pages 71–75, 9 illus.

Pilot's Outlook. Maurice F. Allward. The writer discusses various aspects of the problem of providing the pilot with an airplane affording a good all-round view. It is noted that there is no real criterion by which clearness and range of vision from an airplane can be measured. Different cockpit positions, wing layouts and cockpit enclosures are discussed. German and British aircraft developments directed toward the provision of good visibility are described and analyzed. *Aeronautics*, February, 1945, pages 24–28, 16 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Single Float Seaplanes. A brief investigation of the advantages of single-float arrangements for seaplanes also takes into account the factors that influence single-float design. Variations of the design are illustrated by indicated features of the Vought-Sikorsky Kingfisher, the Curtiss Seagull, and the Nakajima Rufe 2. *Flight*, January 25, 1945, pages 102, 103, 6 illus.

Pickup Airplane Design. Arthur B. Schultz. Explaining the principles and operation of airplane pickup units, this article also discusses desirable features that should be included in the design of pickup airplanes to improve their efficiency. The following basic characteristics are specified as most preferable: high-wing design, twin-engines, loading through a hatch in the "belly," pickup operations to be carried on by copilot, and tricycle landing gear. Miscellaneous requirements that are considered include powering of the pickup unit for its winch action; heating the airplane to provide for the ventilation caused by the opening of the hatch; windshield wipers; and provision for radio reception. *Canadian Aviation*, February, 1945, pages 62, 63, 108, 110, 5 illus.

Undercarriages. An examination of some of the factors in landing-gear operation and their influence on design. The factors discussed include the disposition of the legs with regard to their fully compressed and fully extended positions; the retraction geometry; size of the tire; and degree of springing movement and shock absorption. It is stated that the modern trend in wheel mountings is toward a single telescopic oleo-pneumatic leg carrying a cantilever axle on which the wheel is fitted and encompassing an arrangement to prevent twisting of the leg under the influence of landing drag. *Flight*, January 18, 1945, pages 70, 71, 8 illus.

Electrical Equipment

Induction Motors for Aircraft. H. J. Braun. Originally presented as a paper at a meeting of the American Institute of Electrical Engineers, this article reviews the fundamental characteristics of the three-phase induction motor with respect to its possible application to aircraft. It also summarizes present motor specifications and presents test data on the operation of an induction motor under conditions where one or two leads are disconnected. Common types of motor applications are discussed with reference to the suitability of induction-motor drive for each. Characteristics of motors and various types of loading are illustrated by curve-charts. *Aero Digest*, February 1, 1945, pages 85–87, 151, 153, 155, 157, 11 illus.

Aircraft Electric Systems. Part IV. Francis S. Nelson and G. C. Close. The fourth section of a serial article contains a study of circuit controls and safety devices, noting that the conditions under which such devices operate in aircraft are more severe than in other applications, and that utmost reliability must be obtained despite the severity of the service. Switching devices are discussed at length with respect to the characteristics required, materials, methods of operation, and applications. In a similar manner, the functions of relays, resistors and rheostats, and circuit-protection devices are described. The discussion includes the factors to be considered in the selection of fuses and circuit breakers and the advantages and limitations of the different types of protective devices. *Western Flying*, February, 1945, pages 56, 58, 60, 62, 4 illus.

Engines

Late Developments of the Allison Aircraft Engine. Dimitrius Gerdan. A detailed description is given of the structural improvements that have been made in the Allison V-1710 engine. Requirements considered of major importance in accomplishing these improvements were maximum installation and production simplicity, interchangeability, and flexibility. It is explained that in 1937 a new engine was designed which offered airplane designers an unusual latitude in the disposition of the engine, the cooling system, and the reduction gearing. Two basic engine models, the V-1710-E and the V-1710-F, were used for various installations. The "E" engine incorporates the remote gear box with hollow propeller shaft for cannon use, the engine being located behind the pilot and connected to the gear box through extension shafting. The "F" engine is completely interchangeable with the "E" from the front face of the crankcase rearward for any given altitude and horsepower rating. Either or both engines are readily provided with various reduction-gear ratios, supercharger-gear ratios, or extension-shaft lengths and can be supplied for pusher propellers without the necessity of a redesign of the basic engine. *SAE Journal*, February, 1945, pages 95–102 (Transactions), 24 illus.

Piston Ring Development for the V-770 Engine. Part II. C. H. Van Hartesveldt and M. Epps. Further details regarding research work carried out in the development of a piston ring combination for the Ranger V-770 engine are given in this concluding article. Data obtained from a third test schedule are listed and discussed. *Industrial Aviation*, February, 1945, pages 46, 47, 99, 3 illus.

The Problem of Future Development of Aircraft Propulsion. Boleslaw Szczeniowski. This is the second of a series of articles discussing possible means of improving the aircraft engine and analyzing various ideas for obtaining better performance. An analysis is made of supercharger performance at a rated altitude where the maximum compression is obtained and the supercharger shows the best efficiency. Consideration is then given to supercharger efficiency at low altitudes and at ground level. *Polish Engineering Review*, December, 1944, pages 109–114, 10 illus.

Flight Technique

Flying the Vought Corsair. Part II. Wolfgang Langewiesche. Second article in a series on the piloting of various high-performance aircraft, this is also the second article discussing in detail performance characteristics peculiar to the Vought Corsair. It continues the advice to pilots on the particular things they must know, in addition to their general piloting knowledge, when flying this naval fighter plane. *Air Facts*, March, 1945, pages 56–69, 2 illus.

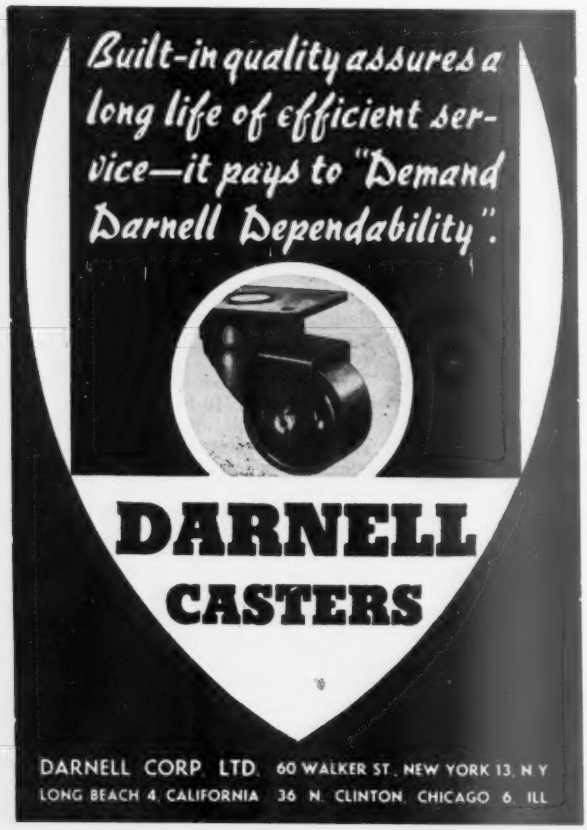
The Automatic Pilot as an Aid to Landing. Group Capt. J. A. McDonald. A method of using the automatic pilot for approach and landing purposes is suggested. The requirements include a reliable and accurate radio or radar instrument-approach system and a connector box whose function is to link the blind-approach system to the automatic-pilot system. Diagrams show the operation of the automatic-pilot approach system. Since the approach to the runway is automatic, the pilot is free to monitor the equipment and attend to his engine, landing gear, and flap controls. Detailed descriptions are given of the localizer system, the glide-path procedure, and the equipment used. *Aeronautics*, February, 1945, pages 29–31, 1 illus.

To Start You Talking. R. G. Worcester. In this series of comments about several major points of contention in the development of aircraft and aircraft components, the writer briefly considers arguments on both sides of each question. The problems discussed are those of high boost and low engine speed, and vice versa; the flying boat versus the landplane; whether the propeller pitch should be adjusted to fully fine position when coming in to land or whether the pitch should be set to give climbing r.p.m.; the correct way to operate boost and engine speed; tire-tread types; radial versus in-line engines; piston versus jet engines. *The Aeroplane*, January 19, 1945, page 88.

Gliding and Soaring

Thermals and Helicopters. Edward A. Quarterman. It is stated that a casual examination of generally distributed facts about performance of vertical-lift aircraft indicates that many of the techniques learned by experienced gliding and soaring pilots should be adapted to the use of rotating wing aircraft. An analysis is made of the effect of thermals on the performance of a hypothetic vertical-lift aircraft. *Soaring*, November-December, 1944, pages 10, 11.

Postwar Sailplanes. Terence Horsley. A forecast of the types, production and maintenance costs, and performance of sailplanes for postwar use. Specifications outlined for the postwar sailplane are that it will sink at the rate of 18 in. per sec. at its best gliding angle; treble its best gliding speed without a disproportionate increase in the rate of sink; turn within a radius of 100 ft. for a sink of not more than 2.5 ft. per sec.; withstand a stress of twelve times its own weight; have an unloaded weight of not more than 600 lbs.; be capable of dismantling by a crew of three in 10 min., and of rigging in 15 min. Features of various prewar sailplanes are discussed as a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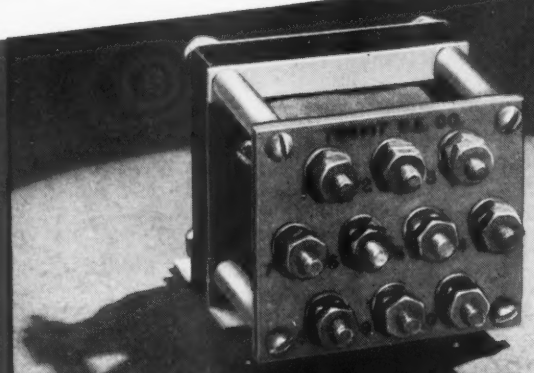

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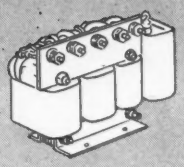

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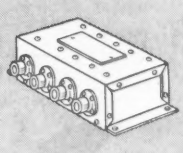
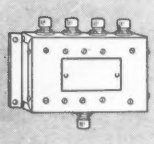
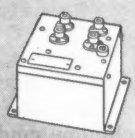
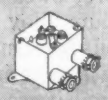






Transformers and ballasts for lighting indicators and instruments



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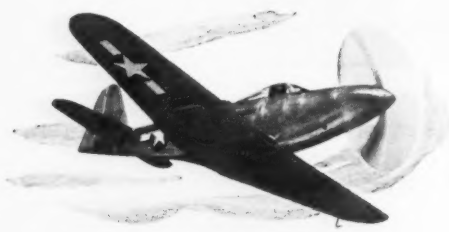

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basis for future types. *The Aeroplane*, January 19, 1945, pages 83–86, 14 illus.; "Pontoon Possibilities," Eric Sloane, *Skyways*, March, 1945, pages 58, 59, 7 illus.

The Ross "17" Sailplane. Vernie G. Ross. Tests and development work carried out in 1942 with a sailplane designated as the Ross "17" are described. The work was undertaken in connection with a project for building gliders for the Army, for which the nearly completed craft was to be used as the prototype. The specifications and a sketch of the R-17 are given. *Gliding*, December, 1944, pages 2–5, 7 illus.

Glider-Tug Performance Studies. August Raspet. In this analysis of towing, the writer gives original numerical data on a glider-tug combination. The principle used in the analysis consists of adding the thrust horsepower required for towing the glider to that required for the towplane. A possible source of error in this technique is noted. Power and performance curves for the glider-towplane combination are shown. *Soaring*, November-December, 1944, pages 4–6, 5 illus.

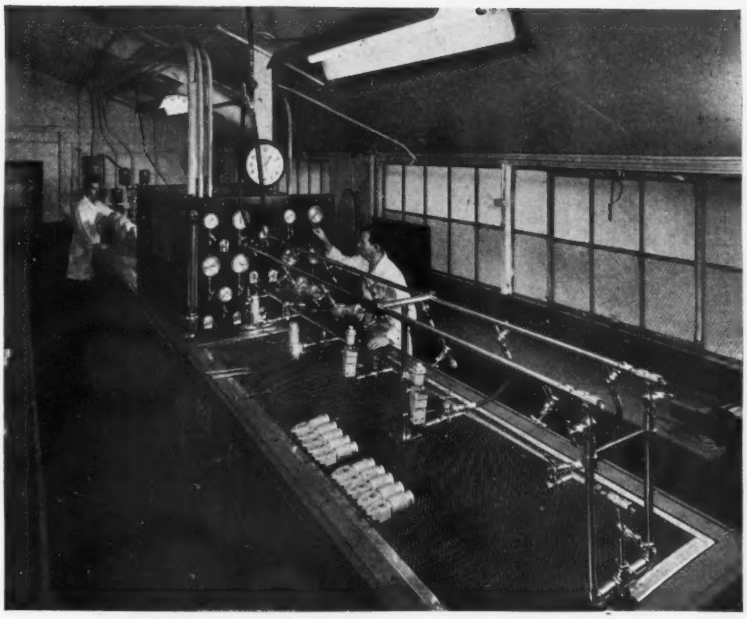
Now, the Ornithopter. As told to Ralph O. Williams. A brief description is given of a flight made in November, 1944, by Belford D. Maule with a 385-lb. flapping-wing glider of his own design. The gull-shaped wings of the glider were moved through a vertical arc of 32 in. by their supporting struts, which in turn were connected to a lever manipulated by the pilot. According to the inventor, the principle of sustaining flight involves not only the vertical movement of the wings, but the simultaneous manipulation of the wings and the control surfaces. *Gliding*, December, 1944, pages 10, 11, 20, 5 illus.

A "One Design Class" Contest Sailplane. Parker Leonard. Suggested specifications are given for a "one-design class" sailplane that would be suitable for construction with facilities available to the average builder of such craft. Designs for such craft are proposed for the stimulation of contests for sport and for the advancement of gliding and soaring. *Soaring*, November-December, 1944, page 3, 2 illus.

Adapting the "One Design Class" to Gliding and Soaring. Paul A. Schweizer. The writer suggests the creation of a "one-design glider class" to encourage the sport of gliding and soaring through fair competition and reasonably priced equipment. Various aspects of the idea are discussed, a comparison being made with the results obtained from "one-design" classes of sailboats. *Soaring*, November-December, 1944, pages 1, 2, 13, 1 illus.

High-Altitude Flying

Problems of Pressurization. A survey of some of the construction difficulties in pressurizing large airplanes for high-altitude flight. Among the phases of the problem examined are the obstacles to pressurizing the entire fuselage, pressurizing only as far as the cabin floor, and maintaining the pressure when it is dependent upon the outer skin of the airplane remaining airtight. The extra weight added to the aircraft by the supercharging equipment is noted. However, it is claimed that, while pressurization will be required for long-distance, transoceanic flights, particularly on the North Atlantic routes, an absolute necessity for pressurized airplanes after the war will be the exception and not the rule. *The Aeroplane*, January 19, 1945, page 82, 2 illus.

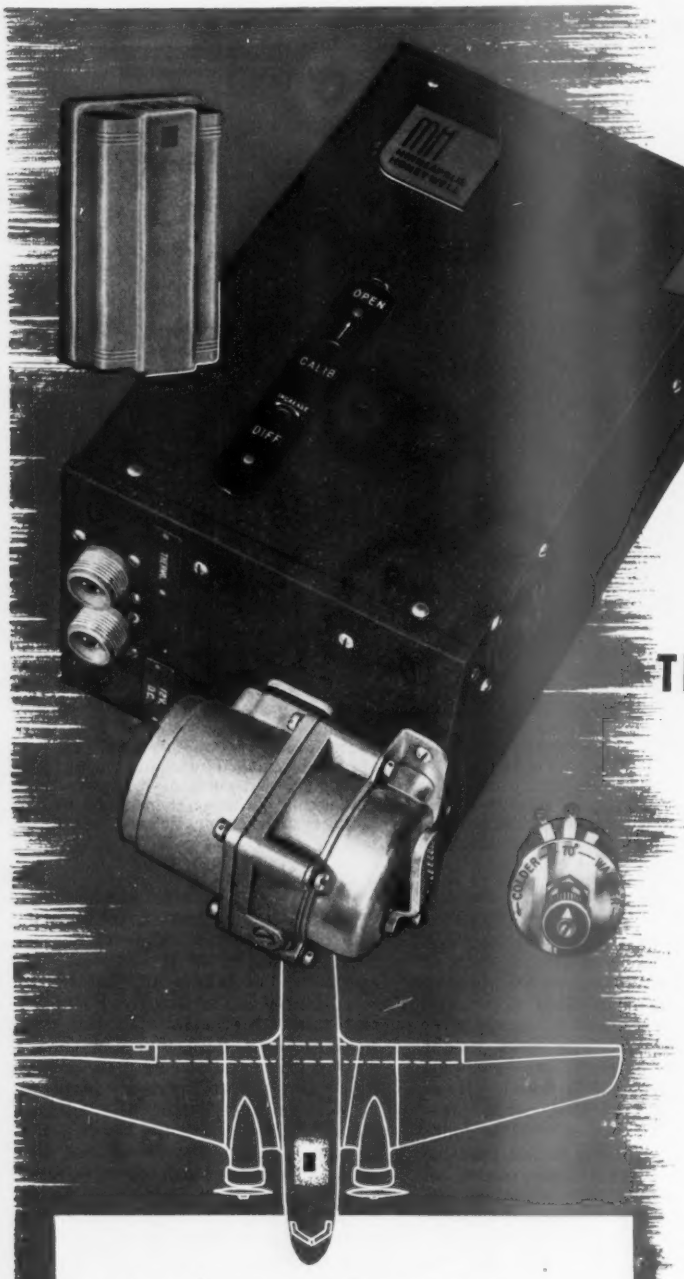


The hydraulic test laboratory designed and installed by the Interstate Aircraft and Engineering Corporation. The laboratory can test many hydraulic units simultaneously under a great variety of conditions. The equipment is divided into two sections, one section capable of testing with pressures up to 3,000 lbs. per sq.in. supplied by a motor-driven piston-type pump with 10 gal. per min. output. The other section will test units up to 1,500 lbs. per sq.in. supplied by a motor-driven vane-type pump with 10 gal. per min. output. Pressures up to 10,000 lbs. per sq.in. can be reached by a hand pump. The laboratory completely filters hydraulic fluid through a two-way mechanism, the first filter reducing foreign particles down to 10 microns, the second reducing them down to $2^1/_2$ microns. The tester incorporates cooling and heating systems automatic in control, which maintain the oil at a specified temperature.

Hydraulics

Causes and Prevention of Leaks in Hydraulic Tubing. Part I. Bernard J. McCabe. A serial article about the hydraulic system of an airplane is confined to the selection of the tubing material, its fabrication into lines, the fittings and their inherent problems, and the installation of the completed system. Part I considers the choice of tubing material and its size, the determination of the wall thickness, and the processes of fabrication. Reasons are given for the selection of the accepted materials comprising aluminum-alloy tubing, copper-silicon-bronze tubing, and corrosion-resistant, seamless steel tubing, specified for pressures ranging from 1,000 to 3,000 lbs. Factors that determine the choice of material are enumerated, and causes of failure attributable to the material are analyzed. Formulas and tables for calculating the size, wall thickness, flare, and flow capacity are given, followed by comments concerning the workmanship involved in cutting and flaring the tubing. Detailed instructions for bending the tubing include precautions for the prevention of the localizing of stresses and the causes of buckling. Later sections of the article will consider the assembly and installation of the completed lines and the problems of their connecting fittings. *Aero Digest*, February 15, 1945, pages 87–89, 104, 106, 8 illus.

Solubility of Air in Hydraulic Oil. Wallace A. Craig and W. B. Layton, Jr. This is a report of the experiments undertaken, the equipment used, and the conclusions derived from tests that were made to obtain a quantitative evaluation of the solubility of air over the range of pressures usually encountered in hydraulic systems. It was found that the solubility of air in hydraulic oil amounts to 10.9 parts per 100 parts of oil per atmosphere of pressure, the air being measured at 760 mm. Hg and 32°F. Developing fundamental data from these test reports to assist hydraulic engineers in design problems, the writers show that the solubility of air



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MINNEAPOLIS Honeywell CONTROL SYSTEMS

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in hydraulic oil is a straight-line function of the pressure that is applied on an air-oil system. *Aero Digest*, February 1, 1945, pages 88, 89, 130, 3 illus.

Inspection

Inspection by Radiography. T. W. Fassett. Particulars are given about the radiographic technique developed by the Alltools London Aeroplane Group Ltd. for the examination of arc-welded tubular structures. Originally employed in the examination of Lancaster engine mountings, this process is not used as a 100 per cent inspection method but only as a check on the welders and welding technique. It is recommended mainly because of its efficiency in demonstrating two faults not easily detected in welded joints: lack of penetration and cracks. This study takes into consideration the application of the process to both tubular welds with plane weld surfaces and tubular welds with curved weld surfaces. *Aircraft Production*, February, 1945, pages 57–62, 21 illus.

Inspecting Aluminum Castings by X-Ray. George Mullowney. A brief article on the application of the X-ray spectrometer to the quantitative and qualitative analysis of small aluminum castings. The article tells how industrial X-ray equipment provided a solution to a manufacturing problem. *Industrial Aviation*, February, 1945, page 38, 4 illus.

Instruments

Load and Strain Measuring Instruments for Use in Rate-of-Loading and Constant-Load Tests. G. W. Foster. A brief article describes special load-and-strain measuring devices for use in determining the strength characteristics of wood under high rates of loading in compression parallel to the grain. The devices were developed for use in tests made at the Forest Products Laboratory, in cooperation with the Army-Navy-Civil Committee on Aircraft Design Criteria. *Instruments*, February, 1945, pages 78, 79, 3 illus.

Maintenance

Service Bulletins Should Serve. Alonzo Gibbs. Information is given regarding the preparation of aircraft service instructions to meet military requirements in war theaters. The writer discusses the gathering of the material, the editing of this technical data, and the information that should be included. Consideration is also given to the make-up and indexing of the publication. *Wings*, February, 1945, pages 1408, 1409, 3 illus.

What Makes Expert Mechanics Expert? Part I. E. F. Lindsley. The first article in a series examining the various phases of aircraft-engine service and overhaul. The intricacies of the engine mechanic's job and the mental attitudes necessary for the efficient performance of his work are discussed. Three major divisions of aircraft-engine maintenance are line maintenance, trouble shooting, and overhaul. Specialized maintenance in propeller, accessory, and instrument overhaul are mentioned. The intricacies of the flight-line mechanic's job are illustrated by detailed descriptions of two routines: supplying the plane with oil and gasoline and replacing spark plugs. A diagram depicts the three prime phases of maintenance and their relation to each other. *Aviation*, February, 1945, pages 216–218, 2 illus.

Clayborne Mfg. Company's aircraft engine overhaul stand. Various makes of radial and horizontally opposed engines up to 225 hp. can be accommodated.

Stretching the Man-Hour. H. R. Williams. The writer describes new methods, procedures, and equipment that have resulted in greater efficiency and safety at the engine overhaul shop of United Air Lines, Cheyenne, Wyo. Various overhaul operations and equipment are illustrated. *Air Transport*, February, 1945, pages 40–43, 9 illus.

Management

Unit Nomenclature. D. Tiranti. A method of facilitating production through the use of a symbolization system is described. The method is based upon the unit breakdown of assemblies, with the establishment of a guide (or nomenclature) for the "call up" of each part at the specific time it is required in the assembly sequence. It is shown how written instructions, giving relevant information for each job, can be prepared with the symbolized nomenclature based on the unit breakdown. *Aircraft Production*, February, 1945, pages 86–88, 2 illus.

From Purple Heart to Plane Production. A. C. Dick. A description is given of the job-placement program devised by the Consolidated Vultee Aircraft Corporation principally to handle a critical labor condition. The experience gained with 4,000 handicapped employees led to procedures that enabled the company to rehabilitate 2,000 ex-service men for useful work. *Wings*, February, 1945, pages 1401–1404, 6 illus.

Time Study. John W. Hendry. The essentials of time study are outlined, its possible applications are considered, and its benefits are indicated. In addition, differences between time study and ratefixing are explained. *Aircraft Production*, February, 1945, pages 101, 102, 1 illus.

Marketing

Aircraft Parts Distribution Plans. Franklin M. Reck. A survey of the preliminary plans that are being made by manufacturers of aircraft parts and accessories to distribute their postwar products. Supplementing a previous report, this second survey deals with the preparations of one aircraft-engine manufacturer, all the tire companies, two makers of propellers, four "dope" and finish producers, manufacturers and distributors of steel tubing and wire, one large airport service station, and producers of such items as carburetors, heaters, small motors, pumps, and filters. *Aero Digest*, February 15, 1945, pages 77–79, 194, 3 illus.

The Coming Competition in Foreign Markets. Part II. Raymond L. Hoadley. Probable sources of competition for American aircraft manufacturers are considered in this second of a series of articles on postwar foreign markets for airplanes. In the discussion, Latin America receives primary attention as a potential market and England and Canada as the potential competitors. The writer explains why those two countries may be expected to vie actively with the United States for airplane sales in South and Central America. He also offers suggestions to United States aircraft manufacturers for meeting this competition and establishing themselves in foreign markets. *Aviation*, February, 1945, pages 116, 117.

Materials

Rationalisation of Aluminium Alloy Specifications. A. E. Russell. An outline is given of the efforts made by designers to build up a fundamentally sound technique for determining the minimum strength requirements of aircraft structures and to avoid unnecessary weight. The control over the specification of aluminum alloys, which contributed to more than half the weight of the structure, is discussed. It is concluded that the progress of research and development on aircraft structures has produced a situation where certain defects, both technical and practical, in the materials of construction have increased in significance. The belief is expressed that the scope of the routine testing of materials should be extended so as to permit a balanced assessment of specification strength values. It is stated that the behavior of materials in compression is best represented by a curve of the ratio of the stress to the tangent modulus plotted against stress. A complete revision of the maximum

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acceptable tolerances of sheet material is advised. It is suggested that any increased cost of materials consequent to the changes would be economically sound from the operations point of view. *The Journal of The Royal Aeronautical Society*, January, 1945, pages 14–20, 3 illus.

Material and Process Selection. E. P. Strothman. This paper on metal selection for a given end product and the determining of the most suitable construction for a product or piece was presented before the Society of Automotive Engineers. "Case histories" are given to help define some "supremacy areas" for alloy steel and steel processes developed for aircraft. These include a case where steel was used successfully for the replacement of magnesium in the B-29 bomber nose frame where weight was an important factor, and landing-gear members where press-formed alloy steel construction was used in place of forged and bolted alloy steel construction. *The Iron Age*, March 1, 1945, pages 40–46, 11 illus.

Organizing Knowledge of Materials. B. C. Boulton. The writer describes a method of organizing the industry's information about old and new materials into factual data to meet engineering demands. Means of curtailing the duplication of effort in various laboratories are suggested. A check list for the characteristics of a metal, prepared by the Douglas Aircraft Company, Inc., at the beginning of a test program to facilitate the organization of the work, is shown. Examples are cited to illustrate the large amount of information required with present design problems. *Product Engineering*, February, 1945, pages 73–78, 4 illus.

Metals Reserve Flow Chart. As prepared by the Aircraft Scheduling Unit, a visual presentation is given of how the Metals Reserve Redistribution plan operates. This plan is concerned with the return to civilian production of metal stocks which have become surplus as the result of contract terminations. It is applicable only to steel, aluminum, copper, and certain items of hardware and components. *Aero Digest*, February 1, 1945, pages 94, 95, 1 illus.

Magnesium Alloys and Their Application. D. A. Tooley. Particulars are given about the characteristics and properties of various commercially available magnesium alloys. Factors that must be taken into consideration in the fabrication of aircraft parts from these alloys are discussed. It is stated that on a pure tensile or compressive strength-weight basis, magnesium alloys do not differ greatly from aluminum alloys, but, from a structural stability point of view, magnesium alloys can frequently be used to great advantage. Some of the disadvantages of magnesium alloys are given. Methods of forming and welding magnesium-alloy sheet are described. The importance of employing chemical treatment or paint to prevent corrosion is stressed. *Machinery*, February, 1945, pages 146–152, 4 illus.

Magnesium Alloys in Design. E. W. Thomas. The writer discusses the use of magnesium-rich alloys in structural design. The constituents of a typical magnesium alloy are listed. Particulars are given about the physical properties of these alloys. Conditions affecting the design stress for compression members are considered. *Engineering*, February 2, 1945, page 84, 2 illus.

Medicine

The Effects of Carbon Monoxide and Altitude on Visual Thresholds. R. A. McFarland, F. J. W. Roughton, M. H. Halperin, and J. I. Niven. This is a detailed report of an investigation into the effects produced by carbon monoxide and altitude on visual thresholds. The studies indicate that carbon monoxide, in much smaller amounts than was previously supposed, may have harmful effects. *The Journal of Aviation Medicine*, December, 1944, pages 381–394, 8 illus.

Effect of Morphine Sulfate on Persons Exposed to Simulated Altitude. Capt. Eric W. Peterson, Murray B. Bornstein, and Capt. Herbert H. Jasper. A report is made on some experiments conducted at the Montreal Neurological Institute of McGill University to ascertain the effect of morphine sulphate on a person's ability to withstand the physiologic effects of anoxia.

The conclusions are: (1) When the reflex excitability of the nervous system is at a reasonably high level, morphine sulphate in a $^1/_4$-gr. dose does not alter a subject's average blood oxygen saturation under conditions of simulated altitude. The ability to respond to oxygen administration was unhampered. (2) When the reflex excitability of the nervous system was not maintained following morphine sulphate, as occurred in the case of two subjects, there was a deterioration in the blood oxygen saturating ability under conditions of simulated altitude. However, the ability to respond to oxygen administration was unhampered. (3) No significant deviation of the electrocardiogram or pulse rate occurred when anoxia was combined with morphine. (4) In the majority of subjects there was an increased amount of slow wave activity in the electroencephalogram demonstrated with morphine at the extreme altitude, 20,000 ft. Although this would have no practical significance so far as air transport of wounded is concerned, its physiologic importance is difficult to assess at the present time. (5) Electroencephalography at present offers no reliable early index of the effect of simulated altitude on the function of the human organism. *War Medicine*, January, 1945, pages 23–28, 4 illus.

Effect of Sulfathiazole on Persons Subjected to Simulated Altitude. Capt. Eric W. Peterson, Murray B. Bornstein, and Capt. Herbert H. Jasper. In this account of some tests, also conducted at McGill University, to determine the possible relationship of sulfathiazole to the effects of travel at high altitude, it is reported that the subjects who received sulfathiazole in full therapeutic doses failed to show any significant deviation in blood oxygen saturation levels, electrocardiogram, or electroencephalogram when subjected to simulated altitudes of 20,000 ft. Conversely, it is stated that anoxia produced in the decompression chamber even at simulated altitudes of 20,000 ft. failed to change in a significant manner the subjective reactions of human subjects to full therapeutic doses of sulfathiazole. From the evidence, it is concluded that the use of this drug for wounded personnel who are to be transported below 10,000 ft., or above 10,000 ft. with supplementary oxygen, is not contraindicated. *War Medicine*, January, 1945, pages 29–31, 1 illus.

Relations Between Force, Major Injuries and Aircraft Structure with Suggestions for Safety in Design of Aircraft. Major George M. Hass. The nature of the injuries received by personnel in aircraft accidents who have been subjected to large forces for brief periods is discussed. Personnel subjected to such accidents are divided into four groups: one that survives severe impacts without important clinical injuries; a second that at the same level of impact receives serious or fatal injuries caused by local contacts between the body and aircraft structures; a third that at a higher level of impact receives serious, if not eventually fatal, internal and external injuries; and a fourth, subjected to the highest level of impact, in which sudden death caused by multiple internal and external injuries is the rule.

The injuries received in each of the four groups are discussed in detail. Consideration is given to the extent to which aircraft design is responsible for these injuries. It is concluded that unduly hazardous structures are present in the cockpit; that the collapse of structural parts in or around the cockpit at times causes serious or fatal injury; and that devices for emergency escape are not adequate. Improvements in aircraft design to provide greater safety are discussed. *The Journal of Aviation Medicine*, December, 1944, pages 395–400.

Physical Competency and Performance. Malcolm Y. McCormick. The writer's experience with the physical examination of motorists and automobile drivers involved in accidents is applied to a study of accident-proneness in aviation. Reasons are given for the belief that findings regarding the relationship of physical deficiency to accidents in the field of motor-vehicle traffic may have some rele-

This is the twenty-first of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME

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"NOW *is the time to plan the world air system of tomorrow so it will work constantly for world peace and progress. For air commerce brings the markets of all the world within reach of every nation and makes it advantageous for every land to remain on good terms with every other, since all will buy from all and sell to all the others.*

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vance to the field of air traffic. *The Journal of Aviation Medicine*, December, 1944, pages 355–359.

The Effects of Altitude Anoxia on the Respiratory Processes. H. Frederic Helmholz, Jr., J. B. Bateman, and Walter M. Boothby. This is a summary of some results of analyses of alveolar gas from persons breathing air at simulated altitudes up to 22,000 ft. and pure oxygen up to 42,000 ft. The data are amenable to simple diagrams, and these are used as a basis for the discussion of several respiratory phenomena. *The Journal of Aviation Medicine*, December, 1944, pages 366–380, 6 illus.

Variations in Illumination of the Depth-Perception Apparatus. H. Wright Seiger. The writer states that variation in lighting of the movable pole during its pathway in the Howard-Dolman apparatus is a possible factor in obtaining dubious results on applicants with monocular vision. Following an analysis of the subject, means are suggested for overcoming the difficulty. *The Journal of Aviation Medicine*, December, 1944, pages 401–404, 1 illus.

Military Aviation

In Close Support. A chronicle of the part played in the aerial war by the fighter squadrons of the R.C.A.F. Figures are given to show the expansion of R.C.A.F. fighter strength since the formation of the first R.C.A.F. fighter squadron. Other information pertains to the tactics of the fighter groups and the value of the support they lend to ground forces. *The Aeroplane*, January 5, 1945, page 15.

With the Higher-Ups. John Yoxall. From a visit to a Mosquito XVI station, a report is given on the activities and operating methods of flight groups using this high-altitude plane. The information pertains to both bombing raids and meteorologic flights made by these groups. Particulars are included about the pressurization and heating systems with which the Mosquitoes are equipped. *Flight*, January 25, 1945, pages 90–93, 6 illus.

Is Battle-Bombing Doomed? Major Oliver Stewart. The writer gives reasons why he believes that daylight assault attacks by heavy bombers are militarily uneconomic. Weighing the higher accuracy of daylight bombing against the larger bomb loads and lower loss rate made possible by undercover, or night, bombing, he predicts the eventual transfer of daylight precision bombing to ultra-high-performance medium and light bombers. The success of the Superfortress daylight attacks against Japan is attributed to the fact that they are at present technically ahead of Japanese equipment, but it is claimed that this "exception to the rule" will cease with the development of more advanced enemy fighter planes, when darkness or fighter escorts will be needed to supplement the Superfortresses, as well as other heavy bombers. *Flying*, March, 1945, pages 52, 148, 150, 1 illus.

The Bell XP-77 all-wood fighter plane, powered by a single Ranger V-770 engine. The plane is 22 ft. $10^1/_2$ in. long, and has a wing span of $27^1/_2$ ft.

The Royal Canadian Air Force. This article deals with the operations, functions, methods, and achievements of the Royal Canadian Air Force. Describing the activities of a Canadian Bomber Command Group and the record of such groups in various campaigns of the war, it also contains comments on the background, history, organization, and size of the R.C.A.F. In the account of Canada's role in the air war, two distinct phases of activities are noted. One is the threefold pattern of overseas participation, encompassing Canadians in the R.A.F., members of the R.C.A.F. attached as individuals to R.A.F. squadrons, and integral R.C.A.F. squadrons serving under R.A.F. operation command. The other phase is the Home War Establishment, including conduct of British Commonwealth Air Training Plan activities. *The Aeroplane*, January 5, 1945, page 10.

Paints and Coatings

Spray Painting. Advice is given regarding efficient methods of spray painting for industrial purposes. Factors for obtaining balance in atomization are listed in operational sequence; the procedure for establishing correct spray setup is outlined; and the technique of obtaining the desired rate of flow is described. The article also contains suggestions pertinent to the quality of finish and the plan of procedure. *Aircraft Production*, February, 1945, page 102.

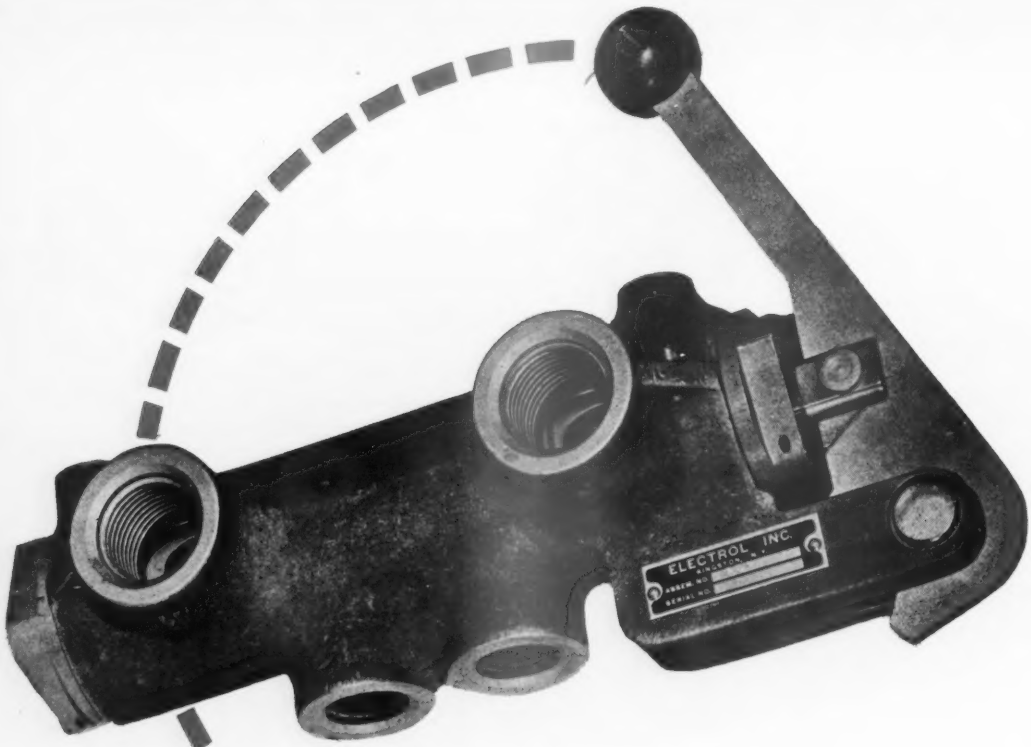
Personalities

Rene Tampier, Inventor. An obituary on Rene Tampier includes a review of his contributions to the development of aviation. Among the achievements with which he is credited are the design in 1922 of an airplane-motor car capable of traveling at 30 m.p.h. along the roads and flying at 120 m.p.h.; the invention and manufacture of the Bloctube carburetor used during the first World War by all manufacturers of rotary engines, including German airplane producers; the design and manufacture of controls for the Halifax, the Wellington, the Hampden, and other types of planes; and the development of hinges for the precision control of ailerons, rudders, or elevators. *Canadian Aviation*, February, 1945, pages 87, 88, 4 illus.

Plastics and Plywood

Precision Is Seldom an Accident. E. F. Lougee. A description is given of how the use of plastics in place of aluminum for important parts of the center scope solved a critical manpower problem in the finishing and assembling of this instrument and also reduced its weight. The writer reviews the development of the center scope, which, it is noted, is a simple device that is slipped into a spindle collet or drill chuck and magnifies the layout lines so that the workman can quickly set his machine in the right position to drill or bore a part. Manufacturing cost savings and design simplifications made possible by the use of plastics for this instrument are described. An outline is given of the way problems connected with the changeover to plastics construction were solved. *Modern Plastics*, February, 1945, pages 112, 113, 194, 196, 3 illus.

Low-Pressure Laminate Plastics. Part I. George H. Tweney. First part of a continued article reviewing the properties, characteristics, and applications of those low-pressure res-



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ins that can possibly be utilized as raw materials for the production of aircraft structural and semistructural parts.

Part I begins with a classification of the commercially available resins into four primary groups: the resinous material occurring in nature and having many of the properties attributed to synthetic resins and plastics; synthetic resins that are thermoplastic in character; the thermo-hardened type of synthetic resin; and the thermo-hardened resins produced by true polymerization. Explaining that the aircraft designer is limited to fibrous materials laminated with thermo-hardened resins, it then goes on to describe in detail the first of the suitable resins to be considered in the continued article—Plaskon 700-2. *Aero Digest*, February 1, 1945, pages 75–77, 140, 6 illus.

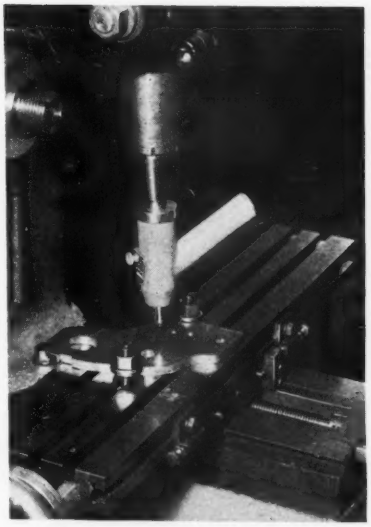
A Fast-Setting Phenolic Casting Resin. J. J. Pyle, E. F. Fiedler, and T. V. Ferris. The progress that has been made in the use of casting resins in the fabrication of aircraft tools is discussed. It is noted that a liquid-type phenolic resin is most commonly used in the preparation of these tools.

Information is given about methods for the preparation of castings which will produce satisfactory shrinking dies, forming blocks, drill jigs, and gage blocks when phenolic resins such as G.E. 1420 are used. Sections are devoted to the preparation of the casting resin, the use of accelerators, the curing of the mixtures, problems of shrinkage, the elimination of voids in castings, and the preparation of the molds. *Modern Plastics*, February, 1945, pages 132, 133, 190, 192.

Let's Systematize Plastics Tooling Information. Forrest C. Tenney. The writer proposes the creation of a common medium for compiling and publishing data and statistics relative to plastics tooling. Lines along which these data could be assembled are suggested. It is stated that the facts could be published monthly by a central committee, composed of plastics and tooling engineers. It is believed that the systematizing of plastics-tooling information would cut experiment duplication, prevent tooling on inadequate data, and stimulate all-purpose material research. *Plastics*, February, 1945, pages 78, 80, 113–116, 3 illus.

Plastic Laminates in Aircraft Tooling. Advantages of plastic laminates in the field of aircraft tooling are outlined. Reference is made to the ease with which they can be fabricated into complex shapes and to the saving in man-hours and manufacturing costs that can be accomplished through their use. The production of a master plaster pattern before the fabrication of the laminated tool is described.

The manufacture of plastic tools is discussed and typical operations are illustrated. *Modern Plastics*, February, 1945, pages 136, 137, 202, 6 illus.



This plastic center scope, manufactured by Center Scope Products, magnifies layout lines so that the workman can quickly set his machine in the right position to drill or bore a part.

Postwar Aviation

Ships and Planes—A Transport Team. Sydney G. Walton. Third article in a symposium of opinion on postwar air transportation. In this article the Vice-President of the Matson Navigation Company advocates the rights of steamship companies to operate transport aircraft in conjunction with surface steamers and indicates advantages that he claims would accrue from such a combination. *Aero Digest*, February 1, 1945, pages 54, 55, 1 illus.

The Air Age Reaches Paraguay. Mary B. MacKrill. The effect of air transport on the economic future of Paraguay, the last of the countries of the Western Hemisphere to be serviced by the inter-American network of air lines, is discussed. How air transport will give Paraguay a chance to reap the full benefits of its fertile soil and as yet unharnessed water power is described. *Air Transportation*, January, 1945, pages 34–36, 1 illus

There's a Prediction for It. Lawrence Keil. This compilation of opinions regarding questions pertinent to the postwar future of aviation stresses the disagreement in the prognostications of various leaders in the aircraft industry.

The questions discussed are: how many planes there will be after the war; the type, speeds, and other performance qualities, as well as prices, of postwar personal planes; the quantities, costs, and possibilities of the helicopter; the numbers, capacities, and costs of planes for scheduled transportation; and the probable rates that will be charged the traveling public.

Among the men quoted are Ralph S. Damon, S. Paul Johnston, A. A. Kucher, Charles I. Stanton, William A. M. Burden, Grover Loening, E. E. Lothrop, C. Bedell Monro, William T. Piper, William D. Hall, W. Lawrence LePage, Col. H. F. Gregory, L. Welch Pogue, A. N. Kemp, E. P. Warner, and Glenn L. Martin. *Flying*, March, 1945, pages 39, 130, 134, 1 illus.

The Shape of Wings to Come. Geoffrey F. Morgan. The writer warns against exaggerated predictions regarding future aviation developments and indicates the need for long-range postwar planning. It is stated that the aircraft industry believes the realities of flight in 1950 and beyond will greatly exceed present standards but will fall short of the extravagant predictions made by some aviation enthusiasts. Future developments in military planes, passenger and cargo transport planes, and private planes are discussed. *Air Transportation*, January, 1945, pages 20–23.

Private Flying

Group Ownership of Lightplanes. Vorras A. Elliott. On the basis of the experiences of eleven groups, the feasibility, costs, and methods of operating a jointly owned private airplane are discussed. Advice is given regarding the management of such groups, systems for sharing expenses, what the fixed and operating expenses consist of and how much they may be expected to amount to, questions of ownership, insurance, and methods of scheduling flights. *Aero Digest*, February 15, 1945, pages 54, 55, 191, 193, 1 illus.

Personal Planes for Personal Gain. Suggestions are made for small businesses that can be established through different applications of the personal plane, as well as ways in which the personal plane can increase the profits of business already established. Among the ideas offered are those involving the use of private airplanes for crop dusting, surveying and mapping, charter services for huntsmen and anglers, aerial ambulancing, convoying provisions to remote regions, selling merchandise of all kinds, and transporting people in the various entertainment and lecture fields. *Air News*, February, 1945, pages 32–34, 74, 15 illus.

Coast Flying Is "Strictly Business." Milton C. Hill. A survey of the type of "personal plane" activities that take place currently in the United States. Exemplified by the operations at Vail Field, near Los Angeles, it is shown that the people who do private flying now are principally business and professional men who devote their flying skill to the war effort. *Western Flying*, February, 1945, pages 40, 41, 84, 10 illus.

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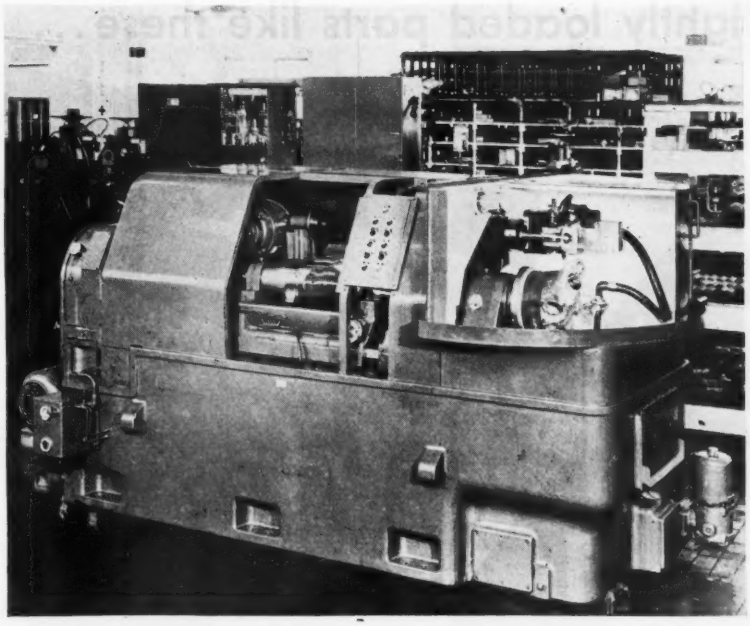
Production

Refractory Molds for Precision Casting. Jules W. Glaser. This article discusses some of the pertinent considerations and techniques applying to the production of the unique refractory molds employed in precision casting. The principal steps of the molding method are enumerated and factors involved in the formation of satisfactory expendable patterns are considered. Rubber molds, soft metal molds, and steel molds are discussed. Consideration is given to the location and size of sprues. Detailed information is included regarding the binder used for high-temperature investments. *The Iron Age*, February 8, 1945, pages 52–56, 9 illus.

Forging Die Design. John Mueller. In this article on the design of forging dies, particular attention is given to the control of the dimensional variations of forgings. The effects of "shrink" or contraction of the metal during the cooling period are discussed. Information is given regarding the variation in the length of connecting rods which was found to occur during normal forging operations. *Steel Processing*, February, 1945, pages 97–99, 6 illus.

Loading and Scheduling a Tooling Department. N. E. Nylin. This is a detailed description of a new method for loading and scheduling a tooling department, which has been developed by tool engineers of the Consolidated Vultee Aircraft Corporation. The method is based on the assumptions that (1) the load of each section is proportional to the number of "equivalent" engineering dash numbers released from the Product Engineering Department and (2) the distribution of this load in each section is approximately triangular. The method of determining the day for starting and finishing a job in each section is described, and the computations are explained with the aid of charts and tables. *Automotive and Aviation Industries*, February 1, 1945, pages 20–24, 42, 44, 13 illus.

Baked Magnesium Sand Mold Inhibited with Potassium Fluoborate. G. H. Curtis. A report on the use of potassium fluoborate as a magnesium-oxide inhibitor in molding sands. The information is based on an investigation conducted at the Dodge Chicago plant of the Chrysler Corporation where this chemical is now being employed as a magnesium-oxide inhibitor in molding sands used in the production of castings for Wright engines. With regard to baking characteristics, shake out, and collapsibility of the molds, more favorable results were obtained with potassium fluoborate than with boric acid. It is stated that, because potassium fluoborate decomposes at relatively high temperatures, its use allows greater latitude in core baking practice. It also may be used as a sand addition agent, thus eliminating spraying and drying operations. *The Iron Age*, February 22, 1945, pages 54–61, 12 illus.



The machining of cooling fins of aviation engine cylinder heads is stated to be increased as much as 30 per cent by using the load control features of Westinghouse Mototrol, an electronic method of speed control for d.c. motors from an a.c. supply (upper left rear). From the shape of the cylinder head in the machine it is evident that the load on the cutter will vary with the depth of metal being milled. The miller was designed by Sundstrand Machine Tool Company. When the milling cutter reaches a no-load area, the feed speed over this section is increased and the time to no-load travel is thereby reduced; and when it engages metal the feed speed is automatically regulated to maintain full load on the cutter regardless of metal depth, resulting in a further saving of time.

Convair Production in San Diego. James L. Kelley. A survey of the production facilities and activities at the San Diego plant of the Consolidated Vultee Aircraft Corporation. Production operations are illustrated and a "flow plan" shows how Liberator assembly lines operate. *Automotive and Aviation Industries*, February 15, 1945, pages 30–32, 34, 70, 72, 76, 7 illus.

Forming and Drawing Steel in Kirksite "A" Dies. C. W. Hinman. A brief article in which the advantages of Kirksite "A" dies for forming and drawing steel are outlined. Reference is made to the extent to which the aircraft industry has adopted these dies, which are suited for the deep drawing of steel parts. Parts formed with the dies are illustrated. *Steel Processing*, February, 1945, pages 107, 108, 3 illus.

Equipment Can Do Twice as Much. H. C. Geppinger. This article describes how a solution was found for the problem of not having sufficient machines to meet production schedules for the machining of airplane-engine manifolds. As a result of an investigation conducted by a man thoroughly acquainted with time- and motion-study techniques, the output of a machine was considerably increased. A "Man and Machine" comparison chart gives a detailed picture of the improvements made and the results obtained. *The Iron Age*, February 15, 1945, pages 64, 65, 1 illus.

Essential Considerations in Interchangeability of Airplane Components. Frank M. Mallett, Stanley W. Gulliver, and David S. Ralph. An outline is given of the essential principles, facts, and methods required to achieve interchangeability of airplane components. The ways and means of achieving interchangeability are given in sections dealing with design, tooling, manufacture, and inspection. It is noted that design is, in a certain sense, the most important of these four subjects of discussion, for, if a component is not designed for interchangeability, no amount of effort on the part of tooling or manufacturing will achieve it. Methods and procedure for solving various design problems are described. Consideration is given to the tools required for the manufacture of parts and to the design of jigs, fixtures, and gages. *Industrial Aviation*, February, 1945, pages 18–20, 22, 92, 93, 3 illus.

Improvements in Static Ferrous Castings Influencing Their Future Use. G. Vennerholm. Important improvements and developments that

Now approved for semi-stressed and lightly loaded parts like these...

WIRE STITCHING STEPS OUT!

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ADVANTAGES OF WIRE STITCHING

EXTREME VERSATILITY: Strongly joins metal to metal, or metal to fabrics, rubber, wood, asbestos, plastics, etc. without backing strip. Readily produces "sandwiches" of rubber, fabrics, asbestos, etc. between two sheets of metal. Combinations almost unlimited.

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NO SKILL NEEDED: An inexperienced workman can become an expert "stitcher" in a few days, as quality of joint is not dependent upon operator's skill. He merely locates work in the machine.

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QUICK, EASY SETUP: Since there are no drilled holes or other items to line up for stitching, clamping and mating of parts to be joined is greatly simplified.

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ECONOMICAL: Power requirements and initial cost of stitching equipment are considerably lower than for any type of welding.

With a tensile strength of 290,000 to 330,000 lbs. per sq. in., U·S·S American Aircraft Stitching Wire will penetrate 2 pieces of 0.030″ half hard stainless steel, type 302 (18-8); two sheets of 24ST Alclad 0.050″ thick; two sheets of 24SO Alclad 0.090″ thick; or a sandwich ¾″ thick of 0.040″ ST aluminum sheets with asbestos between. (Under certain conditions these figures can be increased.)

American Aircraft Stitching Wire provides the seemingly impossible combination of ductility with extreme hardness. Soft enough to form sharp, tight, right-angle bends at all four corners, it clinches flat with a full "line" contact on both sides of the material to insure positive pressure between the parts joined. Yet it is so hard that it punches a clean hole with no tearing puncture of the metal nor burring of the hole.

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have been made relative to static ferrous castings during recent years are reviewed. An analysis is made of the influence they may have on future design and manufacturing methods of the aircraft, automotive, and related industries. *SAE Journal*, February, 1945, pages 103–109 (Transactions), 12 illus.

Car Production Principles as Applied to Aircraft. G. L. Jackman. Continuing a short series about the utilization of the facilities of automobile manufacturers for the production of aircraft components and complete aircraft, the writer surveys the functions of the designing department and of the drawing office. The responsibilities are classified into two main factors: (a) the structural and stress calculations and (b) the adoption of a suitable production technique that can be largely divorced from considerations of aerodynamics and airworthiness. A detailed description is given of the work of the drawing office, with emphasis on the necessity for cooperation between the designer and the production engineer. Comments are made about the production and use of templates, of detailed assembly drawings, and of perspective and "exploded" views. An estimate is given of the personnel required and the cost of operation of a separate production drawing office.

The succeeding article in the series deals with the processes by which the information contained in the drawings is translated into physical production, by means of a routine system. Such a system, based primarily on principles developed in automobile production, is then traced from the receipt of the drawings and the compilation of the lists of parts and the production schedule. Each step in the processes of detail assembly, major assembly, and final assembly is explained, with particular reference to the routing of batches of materials in such a way as to coordinate the entire operation. Estimates are given of the time required for the different steps in construction and assembly. Work sheets, forms, and other records used in control of materials and operations are reproduced. *Sheet Metal Industries*, December, 1944, pages 2138–2142, 2149–2152, 8 illus.; February, 1945, pages 283–291, 9 illus.

Jettison Tanks. L. H. Whatley. A review of the fabrication and assembly methods used by Metalair Ltd. for the production of Hawker Hurricane 45-gal. drop tanks. Following a general description of the tank and its mounting, the 21 progressive phases of its assembly are listed. Illustrated by schematic drawings and photographs, descriptive details about the equipment and procedures of the various stages are included. The concluding portion of the article is devoted to a summary of the ten stages that comprise the finishing operations on the assembled tank. Among the manufacturing processes receiving particular attention are the seaming and drilling techniques, the system of closing the seams, and radio-frequency soldering. *Aircraft Production*, February, 1945, pages 76–81, 14 illus.

Planning and Scheduling Engineering Work. R. M. Zerbe. The method of scheduling engineering work described is defined as the plan of future procedure for the production of the airplane. The relation of the engineering schedule to the master schedule is discussed. Consideration is given to the physical recording of schedule data. Examples of the forms used are illustrated. *Industrial Aviation*, February, 1945, pages 30–32, 34, 37, 95, 96, 8 illus.

Radio

Airline Radio Is Looking Up. Allen Scott. Taking exception to a previous article in which it was stated that aircraft radio "just grew," the writer describes some of the painstaking work that radio engineers have carried out in solving radio design and equipment problems. Some problems yet to be solved are also discussed. *Air Transport*, February, 1945, pages 44, 46, 49, 51, 52, 3 illus.

Eliminating Noise in Aircraft Radio Receivers. Herbert Pyle. The procedure to follow in tracing the sources of noise in aircraft radio receivers is explained. Methods of eliminating noise are described. The article has particular reference to radio-noise elimination in light aircraft, where the set is relatively close to the engine and the electrical system may not be well shielded. *Aviation Maintenance*, February, 1945, pages 56, 106, 110, 112.

Reaction Propulsion

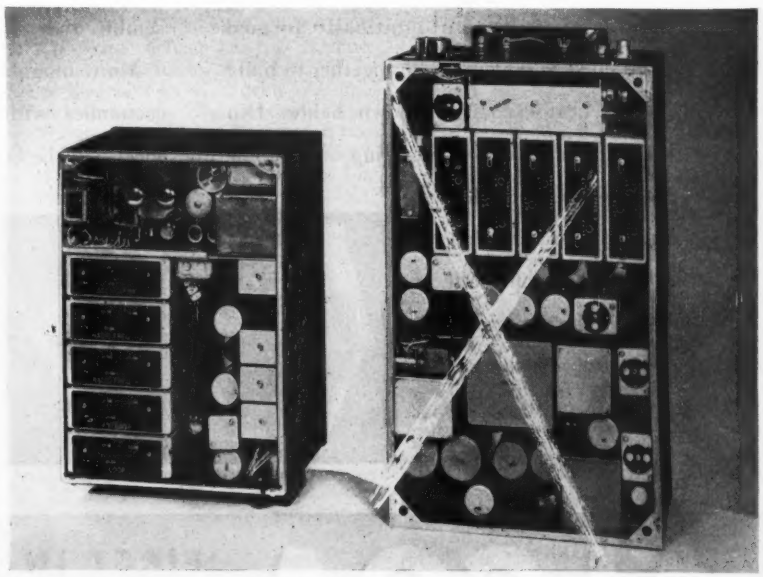
Evaluating the Vaunted V-2. Willy Ley. This analysis of the V-2 considers the German long-range flying bomb from three aspects: its value as a weapon, as a terror or propaganda agent, and as a technologic advance in rocket and aeronautical development. As a war weapon, V-2 is concluded to be ineffectual; as a propaganda weapon, doubtful.

By mathematical computations, it is shown how the V-2 has provided the answer to three problems in rocket development: It has demonstrated that (1) liquid-fuel rockets of mass ratio of about 6 to 1 can now be built; (2) the problem of the fuel pump can be solved; and (3) rocket engines with a fuel consumption of 90 kg. per sec. and thrust of 18,000 kg. or more are possible. *Aviation*, February, 1945, pages 212–214, 2 illus.

Ford Engine for Robot Bomb Tops Nazi V-1 in Efficiency. Blaine Stubblefield. The operation of the impulse-jet engine for robot bombs, now in production at the Ford Motor Company, is explained. The operation of the valves and other mechanism for controlling the mixture and flow of the fuel and air is described briefly. *Aviation News*, February 12, 1945, pages 34, 35, 1 illus.

Reconversion

Demobilizing the Aircraft Industry. Harry Woodhead. The President of the Consolidated Vultee Aircraft Corporation discusses some of the problems connected with the postwar transitional employment of aircraft-industry personnel. Indicating reasons of

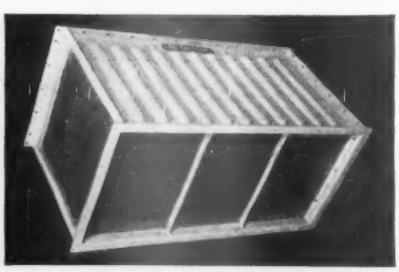


Fairchild Camera and Instrument Corporation's new radio direction finder has a receiver that is 401 cu.in. smaller than the old model and 15 lbs. lighter. Only the regular aircraft storage battery of 28 volts d.c. is required for its operation. Alternating current voltages for the indicator and loop drive motor are supplied by means of a small vibrator from the 28-volt d.c. supply.

These "envelopes" of Alcoa Aluminum brazing sheet are automatically formed and folded so that they slip together to build up the heat exchanger shown below. Dip brazing, an operation requiring only a few minutes, then joins them and the housing into a rigid, gas-tight unit.

When the dip-brazing method of assembly replaced the original gas-welding method, assembly time was cut to a mere fraction.

Many manufacturers have discovered new economies with Alcoa Aluminum brazing sheet and the brazing process. Our engineers will gladly help you fit both into your products. ALUMINUM COMPANY OF AMERICA, 2142 Gulf Bldg., Pittsburgh 19, Pa.



McQuay, Inc., Minneapolis, engineered, developed, and manufactures the Boeing B-17 Flying Fortress' secondary cabin heat exchanger. Heated air from primary exhaust heat exchanger travels in one direction, and fresh air for cabin heat travels in another.

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

capital and markets which account for the industry's postwar inability to employ all its wartime workers, he advocates governmental measures of adequate unemployment insurance, the establishment of suitable agencies for retraining, and provision for transportation to other jobs. He states also that there must be full coordination between the Army and Navy on cutback programs; that aircraft cutbacks should be effective first for those temporary aircraft manufacturers who have postwar markets waiting for them; that cutback notice of at least 60 to 120 days should be given the manufacturers; and that civilian aircraft manufacture should be started at the earliest possible moment.

In addition, he offers pertinent comments with regard to disposal of Government-owned plants and surplus aircraft, continuation of a civilian pilot training program, use of Government-owned airfields not required for military purposes, and permission for aircraft companies to devote part of their present facilities to the development of civilian airplanes. *Commercial Aviation*, January, 1945, pages 38–41, 7 illus.

Reconversion at North American Aviation. Gerald Stedman. An account is given of how North American Aviation terminated the production of the B-25 Mitchell at its Englewood plant and reconverted to expanded production of P-51 Mustangs. Details of the conversion which involved the entire plant are described. Illustrations show the new equipment installed in various departments and the way in which some of the assembly areas were prepared for the P-51 while B-25's were still on the line. Man-hour charts for tool planning, design, and manufacturing are shown, and the "move and progress" schedule is illustrated. *Industrial Aviation*, February, 1945, pages 50, 52–54, 56, 100, 10 illus.

Research

We Must Retain Technological Supremacy. Major Gen. Kenneth B. Wolfe. The Commanding Officer of the Engineering and Procurement Division of the Air Technical Service Command stresses the vital military and commercial importance to America of maintaining an efficient and adequate engineering and research organization supported by an aviation industry that keeps abreast of all new developments. He indicates how present military supremacy was made possible not only by war-stimulated research but also by constant experimentation that was conducted, in spite of opposition, by a small group of commercial and military aeronautical engineers before the war. Examples of aeronautical innovations produced by prewar and wartime research are cited. *Aviation*, February, 1945, pages 113–115, 3 illus.

The Place of Industrial Research Prewar and Postwar. Part II. K. R. Jackman. Second article in a series analyzing the meanings, values, and problems of research as they relate to the aircraft industry. In this article, the writer reviews the rapid growth of research and its distribution in the prewar years as an indication of the probable scope and contributions of basic and applied research in the aircraft industry during the postwar years. With statistics for the year 1938 taken as typical, such factors as the number of people employed in the research field, geographic distribution of laboratories, and division of labor are examined. Pertinent points of view are reported as to the importance of research to industrial progress and the prerequisites for its stimulation. The functions, techniques, and aims of the engineer are compared with those of the research worker, and the place of customer research in future aircraft development is considered. A bibliography follows the article. *Aviation*, February, 1945, pages 203–207, 6 illus.

Rotating Wing Aircraft

Helicopter for Airline Use. C. B. F. Macauley. Details are given about an 18-place helicopter for air-line short-haul and feeder service which is being designed by E. Burke Wilford, President of the Pennsylvania Aircraft Syndicate, Ltd. Designated the WT 18-80, the Wilford "Gyrocopter" is of all-metal construction, except for a portion of the airfoil surfaces, and has a gross weight of 16,000 lbs. It is powered with two 1,050-hp. radial air-cooled engines, either of which will sustain flight. The useful load is 6,000 lbs. Although the main rotor and auxiliary and torque rotors are of conventional design, new and unusual features are incorporated in this aircraft. Details are given about the design of the fuselage, rotor blades, power plant, tricycle landing gear, and expected cost of operation. *Industrial Aviation*, February, 1945, pages 23, 24, 95, 2 illus.

Principles of the Helicopter. Alexander Klemin. In this third of a series of articles on the helicopter, specifications and procedures for the design of a helicopter are studied. These are illustrated by a discussion of five helicopter designs submitted in a competition held at the Daniel Guggenheim School of Aeronautics, New York University. While features of special interest in each design are examined separately, the main characteristics of the designs are summarized in three tables. Two other tables contain the specifications for the competition and a breakdown of the work required in designing a helicopter. *Aero Digest*, February 15, 1945, pages 80–85, 2 illus.

Stress Analysis

Effect of a Small Hole on the Stresses in a Uniformly Loaded Plate. Vladimir Morkovin. Reference is made to a method developed by Martin Greenspan for determining the stress distribution in a large, uniformly loaded plate weakened by a small hole of an approximately ovaloid shape.

It is explained that Greenspan employed a rather laborious method of piecing together particular solutions of the biharmonic equation for the stress function until all the boundary conditions could be satisfied, and that this process would become prohibitive in case of more complicated boundary conditions. The writer applies to the same problem the more general, yet not well known, method for solving plane problems of elasticity, most often associated with the name of N. I. Mushelisvili. *Quarterly of Applied Mathematics*, January, 1945, pages 350–353.

Basic Stress Analysis Requirements in Reducing Aircraft Weight. M. N. Pack and J. A. Gross. The functions of the stress analyst are defined in nontechnical terms, and the various forces to which the structure of an airplane is subjected are explained in a review of the methods followed in testing the strength of such structures. A description is given of the preparations made for a physical test and of the way an actual test of a wing to the point of destruction verified exactly the mathematical calculations of the engineers. The writers describe a method of applying an upload to the upper wing surface by the use of rubber pads cemented to the wing. This technique, using hydraulic pressure to simulate the forces acting on the structure, is stated to be more satisfactory than the shot-bag method. *Aero Digest*, February 1, 1945, pages 90–93, 138, 140, 8 illus.

Theorems for the Synthesis of Simply-Stiff Frameworks. H. Roxbee Cox. As an aid to the aeronautical engineer, the writer presents six theorems for the synthesis of simply-stiff space frameworks. References are given to show where proof may be found for three of these theorems. An informal proof is included for a theorem that the writer believes has never previously been stated. Proofs are not required for the acceptance of the remaining two theorems. *The Journal of The Royal Aeronautical Society*, January, 1945, pages 21–25, 5 illus.

A Good Engine ~~Deserves~~ *must have* GOOD FASTENERS

Camshaft and valve assembly in Ranger aircraft engine, using National Fasteners. Left, Fairchild AT-21 "Gunner" powered by two Ranger 12-cylinder inverted, air-cooled engines.

Our specialty is Aircraft Fasteners.

We make other fasteners, too, but we have been particularly successful in meeting the requirements of the Air Forces.

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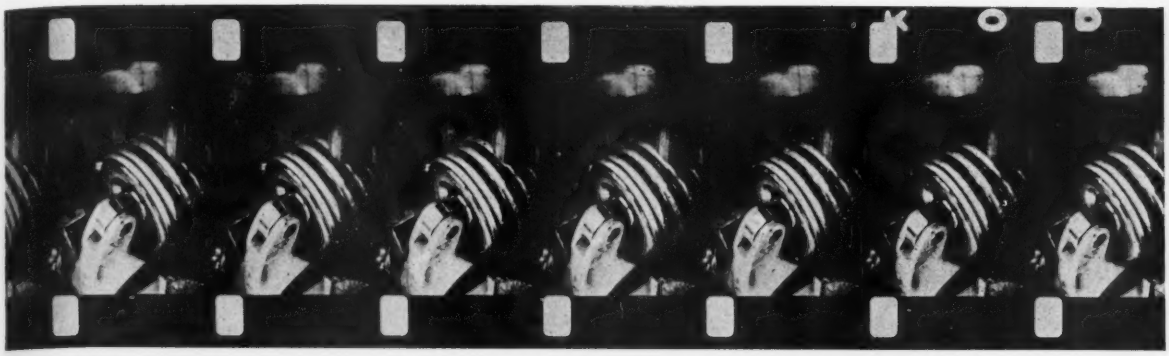

High-speed photographs of valve-gear operation in a large radial aircraft engine. These disclosed faulty operation because of deflections in the mechanism.

The Problem of Saint Venant for a Cylinder with Free Sides. J. L. Synge. Consideration is given to a cylinder composed of homogeneous isotropic elastic material. The cross section is arbitrary and it is assumed that body force is absent and that the sides are free. To the ends are applied any loadings that satisfy the conditions of static equilibrium. As a result, the cylinder undergoes a small deformation. The problem of the stress and displacement in such a cylinder is investigated. Attention is drawn to the work that has been done on the problem, and possible methods of attacking it are indicated. *Quarterly of Applied Mathematics*, January, 1945, pages 307–317, 2 illus.

Analyzing the Strength of Curved Beams. O. A. Carnahan. Part I of a two-part article on the analysis of stresses in curved beams. Formulas are derived for radial tension stresses, shearing stresses, the combination of shear and radial tension stresses, and tangential stresses so that curved members may be designed to withstand all combinations. The formulas for radial stress have been especially developed because they are not incorporated in most books on strength of materials and machine design. It is stated that many failures have occurred through radial tension or a combination of radial tension and shear. *Machine Design*, February, 1945, pages 153–156, 5 illus.

Testing Equipment

Solving Engine Run-In Problems. Frederick A. Heckman. A detailed description is given of the horizontal L-type aircraft-engine test cells provided at the major Naval Air Stations and the developments that have brought them to their present state of perfection. It is explained that each of these test cells is an elaborate and complicated assembly of equipment, the development of which has presented scores of problems. These problems have involved the physical structure within which the engine is tested; the aerodynamics of handling efficiently the blast of air generated by the test "club" or propeller; the problems of mounting engines of various types and sizes; and the problems of simulating, at sea level, flight conditions prevailing at high altitudes. *Aviation Maintenance*, February, 1945, pages 54, 55, 112, 116, 118, 122, 124, 126, 128, 5 illus.

How High-Speed Photography Aids in Redesign. W. S. Calvert and H. D. Jackes. The performance and advantages of high-speed motion-picture cameras in the analysis of mechanical motion are discussed. Other methods of studying motion are mentioned, together with remarks concerning their limitations. Different types of motion-picture cameras and their operation are described. One of these utilizes 35-mm. film driven at high speed past a lens that has no shutter, exposures being obtained by the flashing of an intense stroboscopic light. Another type obtains exposure on a continuously moving film by providing compensation in the optical system for the motion of the film. One of two methods for doing this involves several matching lenses mounted in a rotating member so that the motion of the lens synchronizes with that of the film. Another method utilizes a stationary lens and a compensating prism between the lens and film. The construction and operation of these mechanisms, as well as means for timing the exposures, are explained. A description is given of the application of the device in the study of the functioning of aircraft-engine valve mechanisms, magnetos, and oil pumps. *Machine Design*, February, 1945, pages 133–138, 10 illus.

Testing the Thickness of Non-Ferrous Castings. B. M. Thornton. The writer describes investigations leading to the development of an improved instrument for determining the wall thickness of intricate nonferrous castings, especially those used for aircraft. Illustrations show the instrument, which operates on alternating current, and how it is used in testing. *Engineering*, February 2, 1945, pages 81–83, 10 illus.

Tools and Equipment

How the "Portagraph" Speeds Aircraft Modification. A description of a Remington Rand machine that enables the production from one original drawing of as many blueprints as are needed. It is explained how the process provided by the Portagraph transforms the draftsman's penciled lines into multiple "brown line" duplicates with sufficient opacity to function as vandykes. *Aero Digest*, February 1, 1945, pages 96, 159, 2 illus.

Recent Developments in Swaging. A description is given of changes in the design of swaging machines made to meet wartime requirements, principally in aircraft manufacture. The article has particular reference to machines manufactured by the Standard Machinery Company. Information is given about improvements in the standard swager (known as the Hydro-Former) produced by this company, which is used for attaching swaging ball fittings on cable, for the attachment of tubing to solid fittings, and other purposes; and an all-purpose swager for attaching aircraft fittings to steel cable, which was developed for the Navy. *The Iron Age*, February 8, 1945, pages 50, 51, 3 illus.

Riveting Control Unit Steps Up Efficiency. Thomas A. Dickinson. The construction, operation, and advantages are described of an electronic-sequence control unit for Erco riveters. Called the Mandel unit and utilized by the Consolidated Vultee Aircraft Corporation, this device is credited with effecting a 20 per cent increase in the overall efficiency of automatic riveting operations and a 35 per cent saving in parts. It governs the operations of an Erco riveter by actuating a series of electrical circuits in a suitable sequence. These electrical units, in turn, actuate the various parts of the machine in the required order. A schematic diagram helps to illustrate the functioning of the unit, and a table lists savings in Erco parts which have been achieved with the Mandel equipment. *Western Flying*, February, 1945, pages 48, 90, 3 illus.

Safe Operation of Solvent Degreasers. L. P. Litchfield. Information is given regarding the proper operation of solvent degreasers. Simple procedures that will permit degreasing to be carried out with

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The De Havilland Mosquito bomber is recognized as one of the world's most versatile operational aircraft. This wooden plane has been singularly successful as a fighter and bomber. It is said to have a ceiling of thirty thousand feet and a speed in excess of 400 miles per hour.

Du Pont "Lucite" methylmethacrylate resin sheeting is used for both cockpit and bomb-aimer's enclosures. This crystal-clear plastic has good shatter resistance, tensile and flexural strength and is unaffected by weathering over a wide temperature range. It can be heated and formed to contours having extreme curves.

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COCKPIT ENCLOSURE OF "LUCITE," showing one of the side blisters which provide for unobstructed vision downward and to the rear.

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DU PONT PLASTICS

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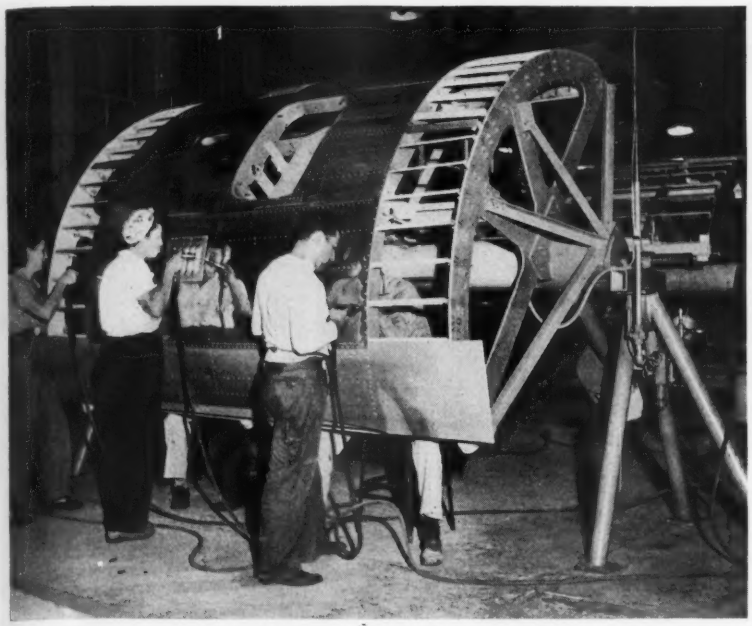

A rotating jig used by the Schweizer Aircraft Corporation for airplane assembly operations.

economy and safety are described. Investigation of the few instances where trouble was experienced revealed the cause to be either lack of knowledge of the properties of the solvent or the proper operation of the equipment. *The Iron Age*, March 1, 1945, pages 58–62, 6 illus.

Forme Tools. G. G. Williams. The design, construction, and advantages of forme tools for various aircraft applications are investigated. Recommended as affording a cheap and quick method of blanking metal and nonmetallic sheet, two types of forme tools are studied: open forme tools and punch and die forme tools. Detailed drawings illustrate the design of the tools. *Aircraft Production*, February, 1945, pages 97–100, 16 illus.

Rotating Jigs for Aircraft Assembly. William Schweizer. The design principles and construction of the rotating jigs used by the Schweizer Aircraft Corporation for airplane assembly operations are examined in detail. These jigs are built on the two-point suspension principle and are balanced so that one person can rotate them with ease. They consist of five primary parts—stand, torque tube, main supporting structure, counterbalance, and line-up attachment structure for the location of the assembly.

After considering the limitations of fixed jigs, the writer gives the advantages of the rotating jigs. He claims that with rotating jigs the number of man-hours required is reduced by about 20 per cent and that the quality of the product is improved without increasing the length of time the assembly is in the jig. Information is included about the functional coloring plan applied to the jig and surrounding areas to facilitate the assembly operations. *Aero Digest*, February 1, 1945, pages 104, 105, 161, 163, 4 illus.

British Developments in Cam Turning. A brief description is given of several design features incorporated in a profile turning lathe for multiple-throw automotive camshafts. The lathe has been developed by the British firm of Arthur Scrivener, Ltd., Birmingham. Photographs show a 24-throw aircraft camshaft being machined twelve throws at a time, as well as the master camshaft and simple longitudinal tool feed. Diagrams reveal special design features of the lathe. *The Iron Age*, February 8, 1945, page 47, 4 illus.

Training

West Coast Training School Provides Glider Pilots to Guide Invasion. Don Mason. This article deals with the Royal Canadian Air Force course of instruction, which has been established at a base in western Canada for training pilots in the special techniques of flying glider tow planes. Besides noting some of the specialized knowledge in which the tow-plane pilots must be schooled, the article includes comments about the men who are in charge of the school. *Canadian Aviation*, February, 1945, page 80, 3 illus.

Air-Age Education. V. L. Gruberg. A national educational program for indoctrinating the general public with "air-age" consciousness is urged for Britain. It is suggested that, starting in elementary schools and going through to the higher age groups, such a program, graded to suit different age groups, should embrace the tuition in all forms of the following subjects: (1) air geography; (2) science of air (including physics and biology); (3) air mathematics; and (4) elementary aeronautical science. *Flight*, January 18, 1945, pages 72, 73.

"Dilbert Dunker." Ens. C. F. Barrett. This is a description of a device developed by the Navy for teaching aviators how to extricate themselves from a plane that has been forced down and overturned in the water. It is explained that the "Dilbert Dunker," which is used at Pensacola Naval Air Station, looks something like a sawed-off airplane. When this plane strikes the surface of the water it turns over on its back. The occupant must escape from his safety belt, shoulder straps, and parachute harness, and then squeeze out of the narrow cockpit while several feet under water. *United States Naval Institute Proceedings*, February, 1945, pages 172–175, 3 illus.

High School Flight Training When? James L. H. Peck. The prospects for a nation-wide high-school flight-training program are discussed. The writer points out obstacles that must be overcome in this campaign to include aviation training in all the country's high schools. It is stated that despite these drawbacks the combined efforts of the Civil Aeronautics Administration, United States Office of Education, and many other national and civic agencies have brought progress to the movement. Advantages of the program are given. *Air Trails*, March, 1945, pages 28, 86–88, 90, 2 illus.

Quality Control. Part II. H. Howell. The concluding half of a two-part article which describes how a new point of view of quality-control principles was applied for the training of machine operators and setters. The point of view involves the interpretation of dimensional quality in terms of the ability of the process to sustain production of the parts in quantity rather than by means of the accuracy of an individual part. Following an explanation of the training technique and the routine followed, as outlined in Part I, Part II contains a detailed analysis of the advantageous results obtained from the training scheme. Various quality-control records utilized in the procedures are illustrated. *Aircraft Production*, February, 1945, pages 65–69, 11 illus.

Thought Patterns and Associations. E. C. Bailly. A discussion of the important contributions made by orderly thought patterns and associations to the ability and efficiency of a pilot. Suggestions are given to the instructor concerning procedures to be followed in instilling these thought patterns in his students. *Air Facts*, March, 1945, pages 50–55.

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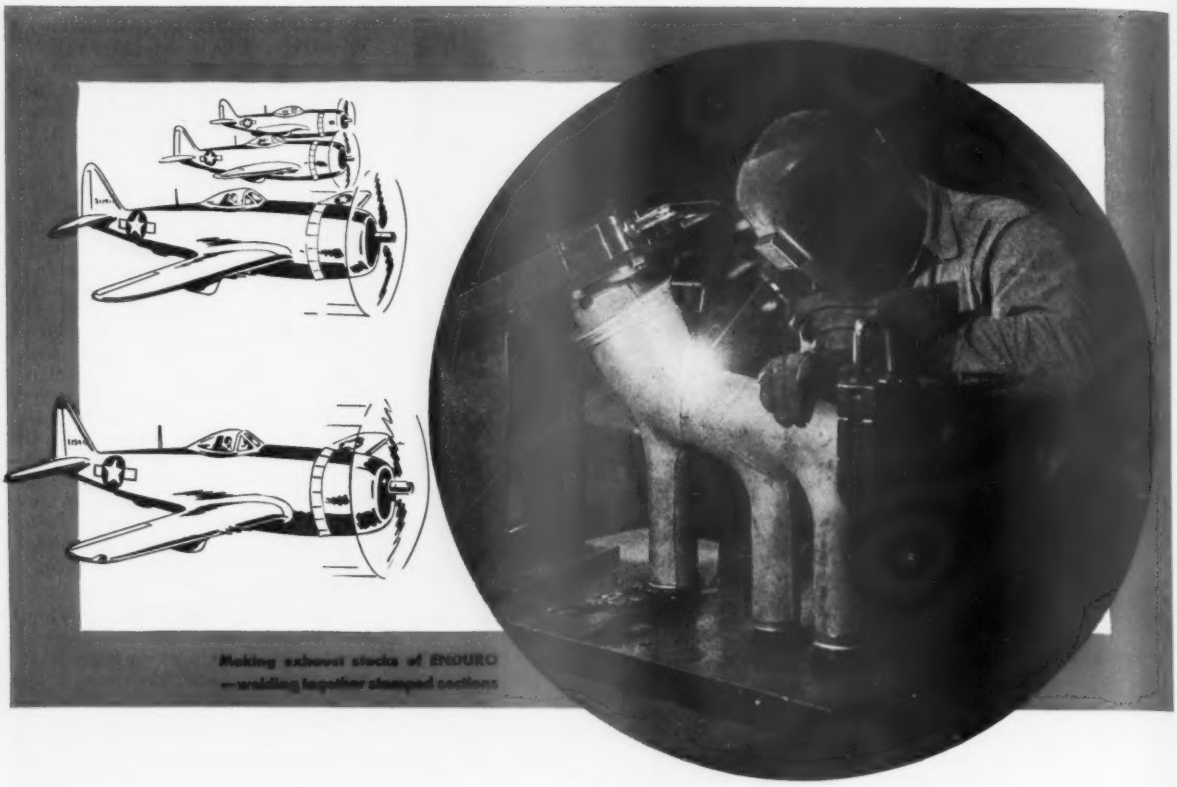

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With a fiery, corrosive exhaust breath of some 1200° F., modern high-powered airplane engines put legendary dragons to shame.

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For that purpose, Republic ENDURO Stainless Steel is unequalled. Its extreme resistance to heat and corrosion combines with unusually high strength to insure safety, light weight and long life for exhaust stacks—the engine "nostrils"—and even for complete exhaust systems of thousands of our victory-winning warbirds.

ENDURO is one of the Republic Electric Furnace Steels—and, as such, is one of the finest steels possible to produce today.

Republic Electric Furnace Steels are "targeted" steels—accurately aimed at product and processing specifications and rigidly held to that mark by the close control possible only in electric furnace melting.

They are consistently UNIFORM—in physical, chemical, hardenability and performance values. They are as SOUND and CLEAN as steel can be made. And they are remarkably free from those small imperfections which can cause rejection at final inspection and prove so costly to manufacturers of items in which labor and machine costs are extremely high in proportion to material cost.

Republic—world leader in electric furnace steels—is ready to tell you NOW how you can use these steels as low-cost insurance of high product quality—and how their freedom from practice-upsetting variables can help you derive maximum benefits from mass production methods of manufacture. Write today to:

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Government Publications

Army Air Forces

Shock Waves at 600 MPH. Major Robert V. Guelich. Some notes on recent compressibility dive tests and the data they have added to existing knowledge of high-speed aircraft performance. As a result of these tests, the following recommendations for avoiding compressibility are given: (1) Do not exceed air speeds corresponding to three-fourths the speed of sound at the altitude at which dives or maneuvers are to be carried out. (2) Avoid violent use of ailerons. (3) Never roll into a vertical dive above 30,000 ft. In this attitude, speed may increase so rapidly that the critical speed may be involuntarily exceeded. (4) At high speed at altitude, use controls gently as if the airplane were near a stall. Do not be in too much of a hurry to recover from a dive because high *g* forces will cause entry into the compressibility range above 20,000 ft. and much more easily than below 20,000 ft. *Air Force*, February, 1945.

Armament of the P-61 Black Widow. The first official announcement of the armament carried by the Northrop P-61 Black Widow night fighter reveals that it carries a total of eight guns. Mounted in the belly of the plane are four 20-mm. cannon. In a power turret just above and behind the pilot are four more 0.50-cal. machine guns. The turret can be power-driven to fire to the rear, with automatic cutoffs to miss the twin tail fins. *Air Technical Service Command.*

Back Home—and Then What? Major Benjamin J. Grant, Jr. This article answers three questions: What rotation is provided for Army Air Forces personnel overseas? Are men who have completed one tour of duty overseas likely to be sent overseas again? What is done with returnees in the United States? The answers are derived from a summary of policies established in Headquarters A.A.F., the Personnel Distribution Command, the Training Command, the continental Air Forces, and other A.A.F. activities involved in the rotation and assignment of personnel. *Air Force*, February, 1945.

New AAF Beacon Light Burns for a Year Without Care. Beacon lights for Army airways, which heretofore have required refueling every 60 days, will be adapted to uninterrupted 12-month service by means of a conversion kit developed at the Equipment Laboratory of the Air Technical Service Command. A twofold problem was solved by the conversion kit. Gales at 65 m.p.h. blew out pilot lights of the beacons used for the last 4 years on mountain tops by the A.A.F. and as route markers by the Air Transport Command. The two fuel tanks with which the beacons were equipped held only enough purified acetylene gas to last 2 months, and it was difficult in winter to refuel and rekindle the beacons.

The solution was found in a beacon that was protected by baffle assemblies to prevent the pilot lights from being blown out, and that was supplied by ten fuel tanks storing enough gas for a year. Operation of the beacon, which consists of three 1-cu.ft. burners with two constantly burning pilot lights, is controlled by a sun valve that turns the beacon on at the approach of darkness and off again at dawn. The sun valve consists of a system of four metal rods protected by a strong glass cylinder. One rod is a thin-walled cylinder coated with lampblack and exposed to the light, while the three other rods are enclosed to protect them from light.

All of the rods expand and contract equally under temperature variations. The black, light-absorbing rod, which is connected to a valve in the acetylene line, expands in daylight to close the valve and contracts to open it at darkness. The beam produced by the beacon is concentrated by a 300-mm. Fresnel lens and reddened to signify danger by the use of a red filter.

Before the baffle assemblies on the beacons received final approval they were tested in the wind tunnel at Princeton University. Protected by the assemblies, pilot lights that formerly were blown out by a 65 m.p.h. gale withstood wind blasts of 110 m.p.h. *Air Technical Service Command.*

"Anti-Exposure" Suit for Airmen. Technicians of the Personal Equipment laboratory at Air Technical Service Command headquarters have developed a new "Anti-Exposure" suit for airmen forced down in Arctic waters. They gave it a severe test recently. Two officers, garbed in the new suit, were immersed in the freezing water. For an hour they lay in the water, encased in the protective cloth of the suit which covers everything but the face. Thermocouples attached to the suits recorded the temperatures of the two men during the test, throughout which no point of their anatomy registered lower than a few degrees of normal.

The anti-exposure suit is made of nylon coated with a substance rendering it both watertight and airtight. The suit is not so bulky as to prevent the "ditched" airman from climbing into his life raft, as was demonstrated during the test. Following an hour in the water, the two officers climbed into a life raft and remained there for an additional 2 hours while the test continued.

One of the officers wore the lightest-weight flying clothing that would be used during winter flying conditions. Following the test, he reported that he was chilled but did not actually suffer from cold. The other officer, dressed in slightly heavier flying clothes under the new suit, stated at the end of the test that he felt no real discomfort whatever from cold. The temperature registered 15°F. during the test. *Air Technical Service Command.*

Large Wing Tanks for Carrying Wounded. A new use for airplane droppable fuel tanks has been developed by the Air Technical Service Command. By redesigning the original jettison tanks, the Command has made it possible for wounded men to be transported in them. The new unit retains only the teardrop shape and shackles of the original models. Resembling a small aircraft fuselage in overall design, it has a transparent nose and controllable air vents. With the addition of wooden flooring a litter can be inserted in the tank, the tail of the tank attached, and a wounded man carried to or from fields too small for larger planes. Standard equipment consists of a mattress running the full length of the tank and a cushion that can be secured from the top to provide a back rest. The stripped tank weighs only 200 lbs., which leaves a margin of 1,800 lbs. for equipment, cargo, or men. Five men can be carried in the unit.

Where redesigned tanks have not been available, it is reported that mechanics have cut the ends off standard drop tanks and installed litters for transportation of wounded. This was possible only when tanks had not been used previously for gasoline.

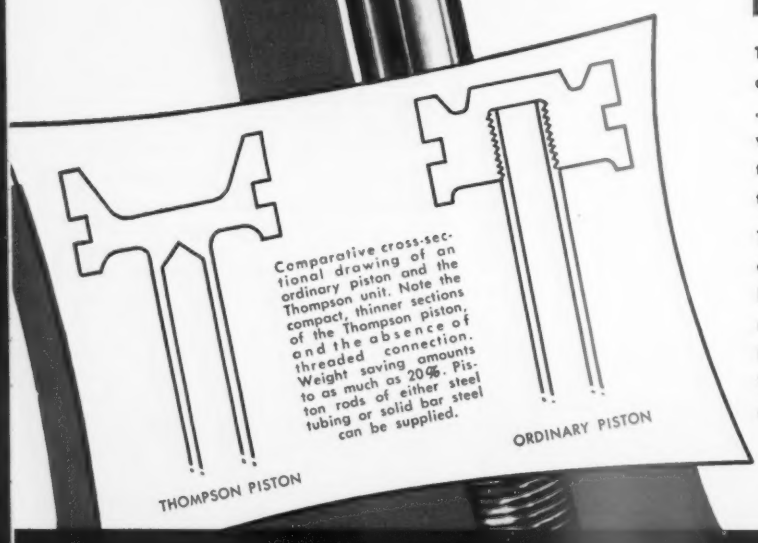
THIS ONE-PIECE HYDRAULIC PISTON

Hasn't a thread in its head!

It is stronger...20% lighter in weight... and better balanced

Conventional hydraulic pistons used in aircraft actuating equipment are made as a *two*-piece assembly, with a threaded connection between piston head and rod. But *this* type of construction greatly increases the amount of metal used, thus adds to the weight. Moreover, extra costly machining operations are necessary . . . the chance of rod loosening and fluid leakage in service are increased . . . and balance is sacrificed because *two* metals, *two* operations, *two* pieces are required . . .

For a number of leading hydraulic equipment makers, the new Thompson *one-piece* hydraulic piston is making a vast improvement in piston performance, service life and safety. *This piston is a one-piece steel forging* that has no threaded connection between head and rod. Large cross-sections ordinarily required (see sketch) have been replaced by the lightweight, thin-sectioned forged head—*without any sacrifice in strength, and in some cases with substantial gain in strength!* Hot-forging produces a grain flow in the metal that follows the contour of the head, thus puts strength right where it's needed most and assures uniform structure throughout. Result: A better-balanced, lightweight piston that completely eliminates the problems often encountered with this equipment!



Comparative cross-sectional drawing of an ordinary piston and the Thompson unit. Note the compact, thinner sections of the Thompson piston, and the absence of threaded connection. Weight saving amounts to as much as 20%. Piston rods of either steel tubing or solid bar steel can be supplied.

HARD CHROME PLATED

Thompson one-piece pistons are accurately heat-treated for strength and toughness end to end . . . ground to ultra-precision dimensions . . . and hard-chrome-plated to provide a smooth, non-scoring, long wearing surface. Elimination of unnecessary production steps through forging, and consequent higher production rates, enable these pistons to sell at a substantially lower cost than ordinary makes.

Thompson Pistons are available in sizes and types for *any* hydraulic application on aircraft . . . such as for operating bomb bay doors, landing gear, cowl flaps . . . for booster work . . . or for any other requirement where positive-operating hydraulic equipment is used. Pistons with head diameters from a fraction of an inch to seven inches are now being produced for many of the latest hydraulic control units. We will be glad to furnish further details, or make recommendations. Write Thompson Products, Inc., WEST COAST PLANT, Bell, California.

ARMY-E-NAVY

Thompson Products, Inc.

WEST COAST PLANT ★ BELL, CALIFORNIA

The new tanks also make it possible for a fighter plane to return from a reconnaissance mission, land, change tanks, and take off within minutes as an ambulance plane, the necessary modification being made in a simple change of tanks. *Air Technical Service Command.*

Civil Aeronautics Board

Do You Study Weather Reports or Just Read Them? Earl L. Smith. Advice is given about how to interpret weather reports. Ten points are explained as a guide for pilots in the study of such reports and it is emphasized that weather information should be used to the fullest extent when making a flight plan. Particular warnings are expressed with regard to the types of weather to avoid, including low-pressure areas, high winds, thunderstorms, precipitation, and showers and squalls. *Safety Bulletin 165.45,* January, 1945.

Why Do Pilots Have Mid-Air Collisions and How Can They Be Avoided? Roscoe B. Bancroft. Analyses of the mid-air collisions that occurred in 1943 are used as examples to illustrate the principles involved in the rules for safe flying, each analysis leading to the statement of one of the rules. It is shown how observance of the rules would have avoided the accident described. A summary of the 31 mid-air collisions of 1943 shows that specific pilot error was the dominant factor in each case and that violations of the Civil Air Regulations were involved in more than one-third of the accidents. *Safety Bulletin 166.45,* February, 1945.

Civil Air Regulations, Part 40—Air Carrier Operating Certification. Civil Air Regulations pertaining to certification of air-carrier operations, as amended to October 10, 1944, are contained in a 12-page pamphlet. The paragraphs are identified by a decimal system of numbering and give the current requirements under the different categories. For sale by the Superintendent of Documents, Washington, D.C., $0.10.

Civil Air Regulations, Part 60—Air Traffic Rules. Prevailing rules amended to August 15, 1944, for the regulation of air traffic are contained in this 22-page pamphlet. In addition to the bold-faced section titles and decimal system of numbering, an index facilitates the finding of specific instructions by reference to the general headings. For sale by the Superintendent of Documents, Washington, D.C., $0.10.

Amended Emergency Flight Rules. The Civil Aeronautics Board has amended the "Emergency Flight Rules," Section 60.95 of the Civil Air Regulations, to reduce the wartime restrictions on civilian flying. The original Emergency Flight Rules were first modified by the Civil Aeronautics Board in December, 1943. Military authorities recently approved this further modification of C.A.R. 60.95. The amended rules provide in part as follows:

(1) Requirements have been waived for the maintenance of guards, or for leaving aircraft in an inoperative condition when unguarded. (2) The listing requirements that aircraft land only at formally designated landing places is being abandoned. Henceforth formal designation will be required only for those fields at which aircraft are regularly to be based, and occasional landings and take-offs may be made elsewhere at the pilot's discretion. (3) Owners of aircraft needing to base them at points not now regularly designated as landing areas may henceforth make application to the Administrator of Civil Aeronautics for the designation of areas that they wish to use. (4) No change is made in the requirement that in eastern and western vital defense areas each individual flight of civil aircraft must be approved by the Defense Command, which approval may be obtained in most cases through the Civil Aeronautics Administration. (5) In certain congested areas, and particularly in the vital defense areas, military authorities may require establishment of local flying areas for each designated landing area, in order to avoid conflict with adjacent military activities. No flight clearance is necessary in vital defense areas when flights are confined to such local flying areas.

Combined Production and Resources Board

Report of Conferences on Standardization of Screw Threads and Cylindrical Fits. A summary report of conferences on the standardization of screw threads and cylindric fits is contained in a pamphlet of 38 pages. The conferences were held in London in August and September, 1944, when a joint United States and Canada mission visited the United Kingdom to discuss with British representatives steps to reconcile the British and American standards of screw-thread design. In addition to a summary of the proceedings and recommendations, there is a brief review of earlier attempts to settle upon common standards for the three nations and lists of the names and connections of the participants.

Department of Labor

Wartime Development of the Aircraft Industry. Prepared by the Division of Construction and Public Employment, this bulletin contains statistics and data concerning the growth of the United States aircraft industry from 1940 to 1944. Following a summary of the information presented in the bulletin, there is a general description of the industry. This, in turn, is followed by a report of employment trends, employment distribution, and production trends. Labor turnover, absenteeism of workers, hours and earnings are discussed. *Bureau of Labor Statistics, Bulletin No. 800,* for sale by the Superintendent of Documents, Washington, D.C., $0.10.

Average Hourly Earnings in the Airframe Industry, 1943. As reprinted from the *Monthly Labor Review* of May, 1944, with additional data, a report is given on the average hourly wages earned in the air-frame industry during the year 1943. Besides the reported figures, factors that affected these earnings are discussed. A summary of the average hourly wage trend in the industry during that year and an explanation of the purpose and nature of the study precede the discussion. There are also appendixes, one dealing with wage stabilization in the air-frame industry; the second with hourly earnings in light-air-frame manufacture; and the third with hourly earnings in the glider industry. *Bureau of Labor Statistics, Bulletin No. 790,* for sale by the Superintendent of Documents, Washington, D.C., $0.10.

Department of State

Interdepartmental Committee on Cooperation with the American Republics. In a pamphlet of 18 pages a report is given of the origin and activities, current projects, recent progress, and other work of the Interdepartmental Committee on Cooperation with the American Republics. The policies of the Committee are outlined and charts show the location of centers, types of projects, and the apportionment of funds expended. *Department of State Publication 2248, Inter-American Series 25,* for sale by the Superintendent of Documents, Washington, D.C., $0.10.

The Library of Congress

Aeronautics in Alaska. This bibliography on aviation in Alaska is an expansion of various reference lists previously prepared by the Aeronautics Division of The Library of Congress. An attempt has been made to include all published matter about flying in Alaska, from 1913 through 1944. References are classified according to the following subjects: general, history, government, flying conditions and problems, military and naval aeronautics, transportation, special uses of aircraft, and postwar aviation. In addition to the names of authors, a supplementary index contains other names appearing in the bibliography, such as the names of pilots, air lines, government departments, etc. *The Library of Congress, Division of Aeronautics,* Washington, D.C.

National Bureau of Standards

Table of Coefficients for Differences in Terms of the Derivatives. Her-

Unretouched photograph of the original Machlett Laboratory

The Machlett "White Room", first in the industry

Machlett Laboratories, Springdale

EVEN 43 YEARS AGO Machlett TUBES WERE PRAISED

Machlett Laboratories, Norwalk

Machlett Diffraction Tube with beryllium window. Used in analyzing quartz crystals for war and other radio purposes, and in metallography.

IN 1902 Dr. W. J. Morton, distinguished scientist, doctor and pioneer in the then-new field of roentgenology, wrote to Robert H. Machlett:

> *"My special tube, as you manufactured it, is truly a success and I don't know how I could obtain anything better. Please make me another one as soon as you possibly can."*

Though little was known about X-rays at that time, one thing was clear to the men using them: the best tubes available were made by Machlett. We believe that is still true today.

The transition from the original Machlett Laboratory to the two modern plants at Springdale and Norwalk, Connecticut, was a gradual process. It was made possible by constant improvement in the tubes, by developing new techniques for their manufacture, and by designing and making new types for new applications. Thus Machlett became the largest producer of X-ray tubes in the world.

Today we also apply our half a century of experience to the production of other electron tubes, such as oscillators, amplifiers and rectifiers for radio and industrial uses. For information as to available types of Machlett tubes, write Machlett Laboratories, Inc., Springdale, Connecticut.

MACHLETT

RAY TUBES SINCE 1897

TODAY THEIR LARGEST MAKER

bert E. Salzer. This table is reprinted from the *Journal of Mathematics and Physics*, November, 1944. It is supplemented with an explanation of the terms employed and a list of references.

Navy Department

New Navy Films. Two new Navy motion pictures have been announced for showings to war-plant audiences. One, "Fortress Japan," reveals the modern industrial structure and strength of the Mikado's empire; the other "LVT—The Beachbuster," is the story of the Marine Corps' versatile amphibian tractor.

In "Fortress Japan," the Nipponese homeland is depicted as an up-to-date, thoroughly modern, industrial nation, politically geared and sufficiently organized for a protracted war. The 18-min. film shows Japan as a completely integrated mass of machines and materials, also as a nation of men and women hardened by training from early youth for the rigors of life-or-death struggle. The subject was produced by The Film Board of Canada and is being distributed to war plants and labor groups in the United States by the Industrial Incentive Division.

"LVT—The Beachbuster" is a record of one of the amphibian tractors whose dramatic actions are increasingly involved in the attacks on Japanese-held shores. The new film, with a running time of 9 min., was filmed by Marine Corps combat camera crews. It follows the history of one "beachbuster" from its proving-ground days, through its debarkation off some Pacific island from a transport, its approach to the beach under naval and aerial gunfire, and its push into the jungle.

Both films may be obtained in 16-mm. and 35-mm. sizes from the 85 official depositories of Army and Navy incentive film. *Industrial Incentive Division, Washington.*

War Production Board

Facts for Industry. The second of a series of releases on United States production of selected combat items shows the output of airplanes, new ships, tanks, etc., that has been accomplished during the past year. In addition to the number and pounds of air-frame weight, the dollar value of airplanes has been added to the data.

The information is based on actual figures for January through November, and on schedules for December, 1944, and January, 1945.

Total production of airplanes during 1944 increased 47 per cent by air-frame weight and 12 per cent by number over the 1943 output, emphasizing the trend toward larger and more powerful models. The figures are tabulated and expressed in graphs, classified into groups including bombers, fighters and naval reconnaissance craft, and transports.

Scheduled production of certain munitions in 1945 will require still greater output and will call for the highest cooperation of labor and management in all plants. The schedules in January, 1945, for bomber, fighter and naval reconnaissance planes, ammunition, and communication and electronic equipment are not only higher than the level of actual production during November, but also exceed December, 1944, schedules. *Military Division, Series 51-2-2,* February, 1945.

British Air Ministry

Air Navigation. Volume I. This Royal Air Force manual presents the principles of avigation. It has been revised and amended to include those advances in technique and procedure introduced into R.A.F. avigation up to June, 1944. The subject matter is divided into twelve chapters, dealing with phases of the main topic as follows: introduction; mathematics; maps and charts; time; the theory of dead-reckoning navigation; position lines; astronomic navigation; magnetism and compasses; wireless direction finding; tactical navigation; round organization; and applied air navigation. There are also several appendixes: one gives a glossary of navigational terms; another shows a navigation log; a third demonstrates a plotting chart; and a fourth gives the R.A.F. Star Charts. *British Information Services,* New York, $2.15.

British Information Services

The Linear Perturbation Theory of Compressible Flow, with Applications to Wind-Tunnel Interference. S. Goldstein and A. D. Young. In the linear perturbation theory of compressible flow, departures of the fluid velocity from a uniform velocity are assumed small and their squares are neglected. The theory is a potential-flow theory; it is at best approximate; it is not intended to be applied when shock waves are present, and it must clearly fail in the neighborhood of a stagnation point. The approximation must deteriorate as the departures of the fluid velocity from the uniform velocity increase, and therefore, in flow past a streamline body, for example, as the thickness and camber of the body increase. In the form of the Prandtl-Glauert formula for the variation of the lift of and the pressure on an airfoil in two-dimensional flow, it is known to give a fairly satisfactory first approximation for Mach Numbers below the shock stall for airfoils of small or moderate thickness, camber, and incidence when the departures from potential flow are not important.

In Part I three variants of the theory are set forth, with applications to two- and three-dimensional airfoil theory and to flow past a streamline body in three dimensions. The results obtained are not new and are largely well known; the writers' object is to exhibit the use of the methods and their purpose is didactic. In Part I they also consider formulas for down-wash at a tail plane and the shaping of wind-tunnel walls to avoid tunnel interference.

Part II contains discussions of the adjustments necessary to all the usual formulas for wind-tunnel interference with straight tunnel boundaries.

In Part III the corrections for a static-pressure gradient down a wind tunnel are considered, together with the general formulas for the forces on a solid body in curved and converging streams. A summary is given of the formulas obtained. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1909,* British Information Services, New York, $1.20.

Statistics Relating to the War Effort of the United Kingdom. A compilation of statistics showing the extent to which the United Kingdom has been mobilized for war during the past 5 years. The pertinent information is presented in five sections: the first referring to man power; the second to home production; the third to shipping and foreign trade; the fourth to civilian consumption; and the fifth to finance. Appendixes, explanatory notes, and charts are included with the text. *British Information Services,* New York, $0.30.

British Ministry of Home Security

Personal Protection Against Gas is one of a series of handbooks produced under the authority of the Ministry of Home Security with the assistance of other British government departments. Its purpose is to provide a general textbook on personal protection against gas attacks and is intended primarily for members of the Civil Defence Services. The chapters refer to the nature and properties of war gases, gas attack from the air, detection of gases, protective measures, respirators, and preventive treatments. *Air Raid Precautions Handbook No. 1, 3rd Edition, 1944;* His Majesty's Stationery Office, London, 6*d*.

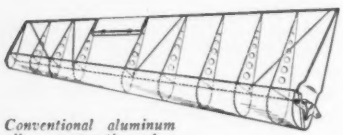
Training in First Aid for Civil Defence Purposes. This revised handbook gives up-to-date instructions for

SKYDYNE

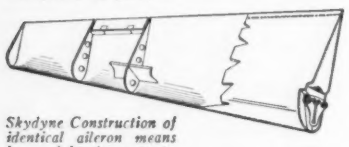
SANDWICH CONSTRUCTION

FOR LIGHTER, STRONGER AILERONS

Examine a Skydyne aileron in cross-section, and you'll see why it *weighs less.* Notice, the absence of extraneous reinforcing elements. Notice the low-density core on which the strong outer layers of Skydyne are laminated. Yet, weight for weight, Skydyne is *stronger.* For the strength of Skydyne is one of the remarkable characteristics inherent in the Sandwich Construction itself.



Conventional aluminum alloy construction of a typical aileron requires multiplicity of parts.



Skydyne Construction of identical aileron means less weight, fewer parts, simpler design, plus smooth, streamlined surface.

Plane parts form-molded by Skydyne have a smooth, streamlined, rivet-free surface of aluminum, plywood, wood fiber or other facing material. Exact design specifications, including complex shapes and curvatures, are achieved with easily-constructed molds and jigs—making the cost of Skydyne surprisingly low even in small series production.

Skydyne aeronautical engineers have had years of experience in the development of Sandwich Construction for aircraft surfaces and airborne equipment. They will be glad to discuss your specific construction problems at any time—and to help you BUILD LIGHTER PLANES . . . FOR LARGER PAYLOADS...WITH SKYDYNE!

Literature on request

Skydyne Inc

PORT JERVIS, NEW YORK

members of the Civil Defence Services with regard to the training and work of rescue parties organized to render aid to the civilian population during air raids. The first part refers to the organization of rescue parties and their duties, and the second part gives detailed instructions for first-aid procedure in caring for casualties. The booklet was prepared in conjunction with the Ministry of Health. *Air Raid Precautions Handbook No. 10, 2nd Edition, 1944;* His Majesty's Stationery Office, London, 6*d*.

British Air Ministry Translations

The list below supplements those published in previous issues of the AERONAUTICAL ENGINEERING REVIEW.

Aeronautical companies and other organizations may borrow copies of these translations through the facilities of The Paul Kollsman Library upon application by the company librarian. Because of the importance of this material, the regular library loan period has been extended to two weeks, in order that these translations may be utilized to their full advantage. Requests should be made by number, author, and title on the regular Library book request cards. Because of the many requests for these translations, no more than five copies may be borrowed at one time by one organization.

The translations have been reproduced from typewritten copy, and the number of pages in each is indicated at the end of each reference. Bibliographic information has been taken directly from the translations. Photostatic copies are also available at the usual library rates.

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2343 Weise, E. *Physical properties and technical uses of semi-conductor resistances.* Elektrotechnische zeitschrift, v. 59, no. 41, October 13, 1938, p. 1085–1089. 9 p.

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2345 Kinner, W. *The principle of the potential theory applied to the circular wing.* (Dissertation, Göttingen) Ingenieur archiv, v. 8, 1937, p. 47–80. 45 p.

2346 Dreyer, K. L., and Hansen. *The avoidance of coarse grain size in sheets of magnesium-copper-aluminium alloys through repeated critical deformation and cold work.* Zeitschrift für metallkunde, v. 34, no. 6, June 6, 1942, p. 121–125. 9 p.

2348 Hanemann, H., and Bernhardt, E. O. *A micro-hardness tester.* Zeitschrift für metallkunde, v. 32, no. 2, February, 1940, p. 35–38. 7 p.

2350 Fischer, K. *A new method for volumetric determination of the water content of liquids and solids.* Angewandte chemie, v. 48, no. 26, June 30, 1935, p. 394–396. 6 p.

2351 Zinke, O. *Sideband and swinging vector theory of frequency modulation for sinusoidal and rectangular modulation.* Elektrische nachrichtentechnik, v. 20, no. 4, April, 1943. 15 p.

2352 Keller, C. *The place of research in turbine design.* Escher Wyss mitteilungen, no. 15-16, 1942–43, p. 42–53. 15 p.

2353 Roth, H. W. *The temperature distribution in light alloy blocks during heating and cooling.* Zeitschrift für metallkunde, v 33, no. 1, January, 1941, p. 13–15. 5 p

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2356 Schnorrenberg, W. *German standard specifications.* Aluminium alloys, wrought, cast or secondary. Aluminium, v. 25, no. 7-8, July-August, 1943, p. 267–269. 30 p.

2358 Guerra, G. del. *120-ton crocodile truck.* Rivista tecnica delle ferrovie italiane, v. 31, no. 10, October, 1942, p. 321–327. 8 p.

2359 Matarelli, G. *Measures for increasing the useful load of four-wheel railway trucks.* Rivista tecnica delle ferrovie italiane, v. 31, no. 9, September, 1942, p. 314–316. 4 p. (Abstract; complete article published in Glaser's annalen für gewerbe und bauwesen, December, 1941).

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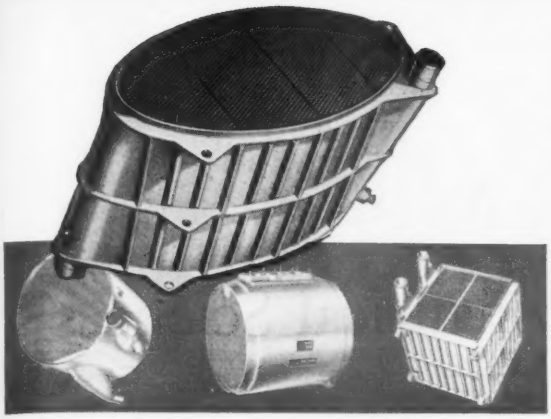


DESIGNERS WELCOME ALUMINUM BRAZING

Before discovery of the way to braze thin aluminum tubes intimately to aluminum header plates and shells, designers of heat transfer units were limited to use of copper in conventional shapes unless they reinforced the structurally-weak copper. That's because soft solder used with copper — even at its best relatively low in resistance to temperature, pressure, vibration and shear — can't stand the uneven stresses resulting from departure from conventional shapes.

NOW DESIGNERS HAVE NEW SCOPE

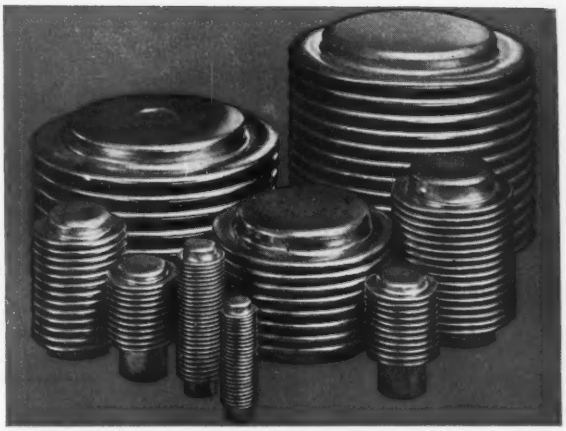
Clifford's discovery of aluminum brazing gives designers greater scope in planning the shape of heat transfer equipment. That's because:

1. All-aluminum units save ⅔ the weight of copper in the same size and shape.
2. Heat-treatable aluminum alloy tubes stand up under temperatures which gradually anneal and weaken copper.
3. Aluminum alloy brazing material is several times higher in resistance to temperature, pressure and strains than soft solder.

So it's easy to see why USAAF designers gave several shapes of Clifford Feather-Weight Oil Coolers and Coolant Radiators a chance to make good in several types of aircraft.

LOOKING AHEAD

Right now Clifford's production is devoted exclusively to war work; but inquiries and suggestions about post-war automotive, heating, cooling and ventilating applications of all-aluminum heat-transfer units will be welcomed. *Clifford Feather-Weight . . . Save ⅔ the weight . . . same size and shape.* Clifford Manufacturing Co., 560 E. First St., Boston 27, Mass.



IN HYDRAULICALLY-FORMED BELLOWS alloys are chosen with care

Pure metals and many alloys are unsatisfactory for bellows because they lack the necessary spring properties when cold-worked.

A hydraulically-formed bellows — made by forcing a cold tube between the plates of a collapsible metal die by internal hydraulic pressure — requires a metal of good deep-drawing properties and reasonable resistance to corrosion.

80-20 BRASS IS BEST

A brass consisting of 80% copper and 20% zinc is the best alloy because it has excellent deep-drawing properties, is not readily subject to "season cracking", receives required spring-action from cold-working.

PHOSPHOR BRONZE ALSO GOOD

Next in importance is phosphor bronze containing essentially 95% copper and 5% tin. It has properties similar to brass and is more resistant to corrosion. Being higher in cost, it is restricted to specialized cases.

SPECIAL ALLOYS AVAILABLE

Where resistance to corrosion is more important than resistance to mechanical fatigue, copper-nickel series alloys have been successfully used for bellows in hot water systems and high pressure steam devices.

CLIFFORD HAS ALL THE FACTS

Clifford, first to produce hydraulically-formed bellows for industry, has kept abreast of progress in metals . . . and is therefore equipped to supply you with these uniform, pretested bellows in all practical alloys . . . either alone or in highly engineered assemblies. For proof that Clifford is *First with the Facts on Hydraulically-Formed Bellows*, write: Clifford Manufacturing Co., 560 E. First St., Boston 27, Mass.

CLIFFORD *Feather Weight* **OIL COOLERS AND COOLANT RADIATORS**

HYDRAULICALLY-FORMED BELLOWS HYDRON

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This lending library service makes available, *without charge*, the latest and more important aeronautical books.

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Members may request the loan of any aeronautical or technical book they wish to borrow. Through an exchange agreement with the Engineering Societies Library, any book on general engineering may be borrowed from its great collection of over 160,000 volumes.

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Applications for membership in the library and further information will be sent on request.

The Burden Reference Library

This reference library contains over 14,000 aeronautical books, magazines, pamphlets, photographs, reports, and clippings gathered from world-wide sources and is one of the most complete aeronautical libraries in the world. Material from this library is not available for loan but may be used for reference purposes at the Aeronautical Archives.

The Pacific Aeronautical Library

6715 Hollywood Boulevard
Hollywood, California

Established in cooperation with the aircraft companies the library serves. The leading aircraft companies in or near Los Angeles participate in its support and operation.

This service library for aeronautical research is available to the public for reading privileges. Source material includes aerodynamic and structural research reports, as well as books on drafting, production methods, history, and allied sciences. It furnishes books, periodicals, and pamphlet material to the participating aircraft companies to supplement their engineering libraries.

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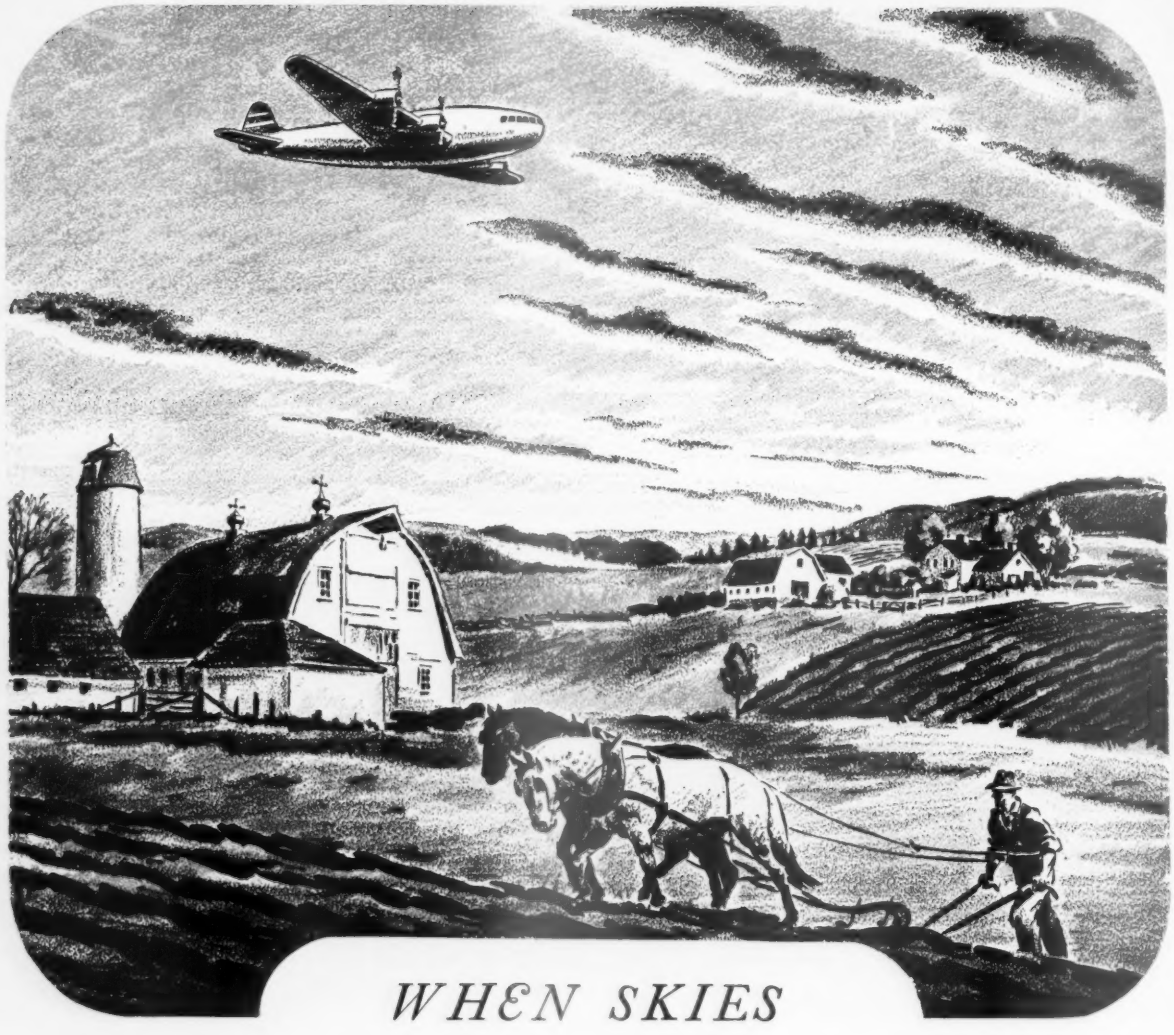
Hauling the Load over the HUMP

Air Transport Command operations in the China-Burma-India area have become a symbol of reliability and endurance, both of men and equipment—a reputation built on day-in, day-out, all-weather flying over the world's roughest terrain, often under attack. The performance of Curtiss Propellers on C-46 Commandos along this aerial Burma Road typifies their dependability in air transportation.

Curtiss-Wright Corporation, Propeller Division

CURTISS
ELECTRIC PROPELLERS



WHEN SKIES ARE PEACEFUL AGAIN

When the sight of a plane means a wave of the hand instead of diving into a foxhole . . . when it's passengers and parcels instead of bullets and bombs . . . you'll find thousands of commercial and private planes winging their way through the skies dependably and economically . . . on Holley Carburetors. For almost half a century, through war and peace, Holley Carburetors have provided the utmost in carburetor dependability.

HOLLEY

AIRCRAFT, AUTOMOTIVE, MARINE

CARBURETORS AND ACCESSORIES

Jane's All the World's Aircraft, 1943–44

Compiled and Edited by
Leonard Bridgman

Contents: Part A, The World's Aeronautical Progress, Historical (Service Aviation); Part B, Historical (Civil Aviation); Part C, All the World's Aeroplanes; Part D, All the World's Aero-Engines.

Again, under the able editorial supervision of Leonard Bridgman, this thirty-third issue carries forward the record of international aircraft development. Even under the restrictions imposed during wartime the annual is an invaluable compilation of historical information and technical data for those who wish to follow the progress of aeronautics throughout the world.

Beginning with a chronology and outline of the fourth year of the war in all theaters of operation, the customary sections on the organization of the air forces of all countries follow.

The parts of the book devoted to airplanes and to aero-engines are, as usual, as complete as possible under existing conditions. Pictorially and statistically they have become a standard reference source for accurate information about the products of the world's aircraft industry. Civil aviation also is stressed even though it has been so largely militarized for the duration.

J. M. Spaight contributes a study titled "The Waning of German Air Power" which shows the damage done to the German aircraft industry and to the Luftwaffe during 1943. This essential book occupies a place in every aeronautical library which no other volume can replace. Sampson Low, Marston & Company, Ltd., London, 1944; various paging, $19.

Aircraft Armament

Louis Bruchiss
Edited by Glenn D. Angle

Contents: Aircraft Bombs; Aircraft Machine Guns; Aircraft Cannon; Ammunition; Turrets; Foreign Aircraft Weapons; Armor Protection; Anti-Aircraft Weapons; Gunnery Training; Self-Propelled Ammunition and Bombs; Future Aircraft Weapons and Air Warfare.

Practically all of the important information about aircraft armament released thus far is presented in this book, which bears the authority of approval by Government officials. It describes, with hundreds of illustrations, the armament required for strategic and tactical operations.

Starting with a chapter on the early history of aerial fire power, there follow detailed descriptions of the various types of bombs, machine guns, and cannon used by airmen. Ammunition, anti-aircraft weapons, and armor protection are also set forth with commendable detail. Looking toward the future of air warfare and air weapons, an examination is made of self-propelled ammunition, such as robot bombs, rockets, and jet propulsion, with as much information given as present restrictions allow.

The whole presentation is timely and compact and gives the knowledge required to appreciate the great progress made in aircraft armament. Aerosphere, Inc., New York, 1945; 224 pages, $6.00.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Fighters Up

Eric Friedheim and Samuel Taylor
Edited by Arthur Gordon

Contents: A Day with Dave Schilling; "B" Channel Brings Them Back; A Snapshot of Berlin; They Couldn't Wait; Berlin Across the Board; Blakeslee's Bachelors; Four Men with a Purpose; Angel in Overalls; Bennett's Bridge Busters; Old Man River; The Dogpatch Commandos; The Opposition; The Main Event; These are the Aces.

The Eighth and Ninth Fighter Commands operating in the European theater have made records that have brought their pilots great fame. They have flown Spitfires, Lightnings, Thunderbolts, Mustangs, and Black Widows, and the rivalry between the squadrons has been keen. The book gives the history of these commands from November 26, 1943, up to January, 1945.

Many of the pilots who have made high scores in shooting down enemy aircraft tell their story in their own words. Specialized missions, such as photographic flights, night operations, patrols, and other assignments are described so that the reader receives an overall view of the work of fighter pilots.

Especially noted are the opinions of the pilots regarding their particular fighting planes and the high degree of specialization required of each new type.

The book should prove to be an added incentive to those who have a part in the production of these highly developed machines. When they read of the hundreds of victories and how the pilots outfought their enemies, it will be evident that each new Allied fighter plane brings the war closer to its end.

At the end of the book the names of 340 pilots who have had five or more victories each are listed. Although the list is incomplete with respect to the more recent records, it shows impressively the superiority of skill and equipment of the American airmen. MaCrae-Smith-Company, Philadelphia, 1945; 275 pages, $2.50.

The Modern Gas Turbine

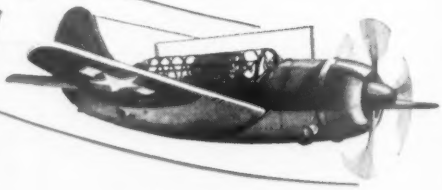
R. Tom Sawyer

Contents: Fundamentals; Early Inventions and History of the Gas Turbine; The Gas Turbine Using Diesel Engine Exhaust Gases, as a Supercharger or as a Prime Mover; Combustion Gas Turbine Calculations and Efficiencies, by Ronald B. Smith; The Gas Turbine in Industry; The Gas Turbine in Marine Service; The Gas Turbine Locomotive; The Exhaust Turbosupercharger on Aircraft Engines; The Gas Turbine as an Aircraft Prime Mover, Including Jet Propulsion.

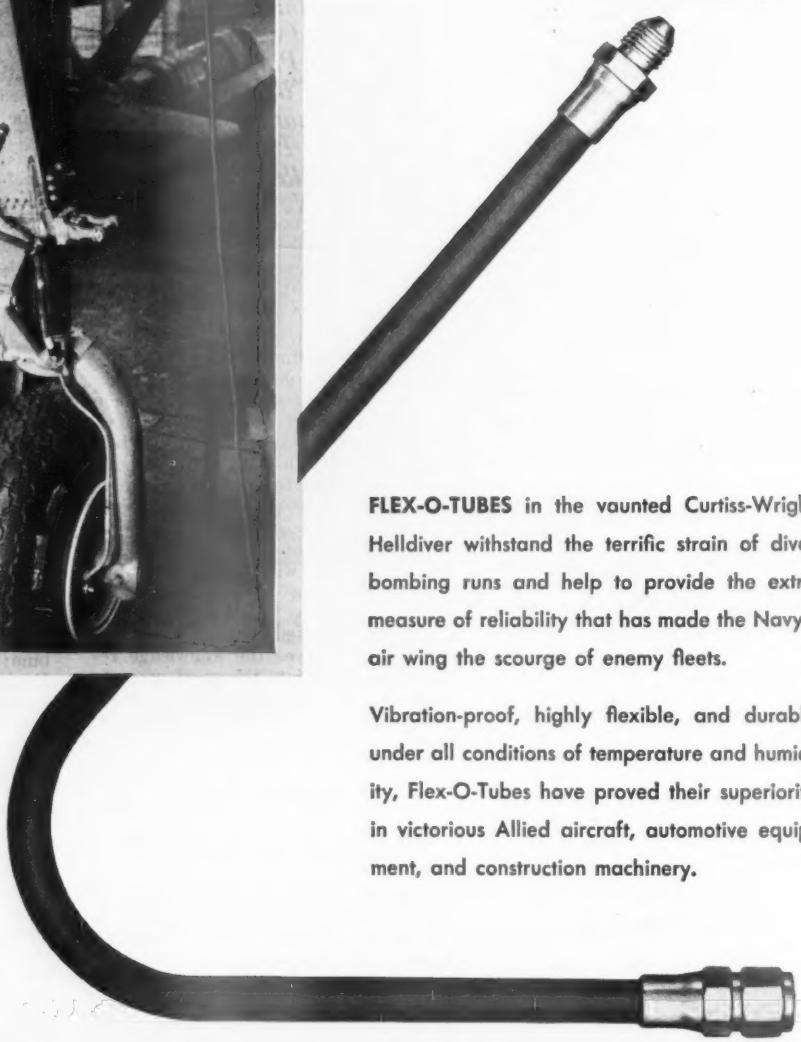
Information regarding the latest applications of the gas turbine as a supercharger and prime mover in all fields of service is included in this volume. The text is fundamental in the sense that highly mathematical calculations are omitted.

One section of the book is devoted to exhaust turbosuperchargers for aircraft engines. There is also a chapter on the gas turbine as an aircraft prime mover, including a study of jet propulsion. The material in this chapter, except for theoretic calculations and the performance characteristics resulting therefrom, is based on the book *Gas Turbines and Jet Propulsion for Aircraft* by G. Geoffrey Smith. Detailed calculations on the comparative performance of a turbine-jet unit, a radial engine, and a gas tur-

HELLDIVERS MUST STRAIN



Landing gear of Curtiss-Wright Helldiver showing Flex-O-Tube assembled for hydraulic brakes. (Photo courtesy Canadian Car & Foundry Co.)



FLEX-O-TUBES in the vaunted Curtiss-Wright Helldiver withstand the terrific strain of dive-bombing runs and help to provide the extra measure of reliability that has made the Navy's air wing the scourge of enemy fleets.

Vibration-proof, highly flexible, and durable under all conditions of temperature and humidity, Flex-O-Tubes have proved their superiority in victorious Allied aircraft, automotive equipment, and construction machinery.

Let Flex-O-Tube Engineers, with many years of experience in designing hose assemblies for specific applications, assist you in your wartime and postwar problems.

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bine-propeller unit are presented by the author.

The chapter on gas-turbine calculations and efficiencies is contributed by Ronald B. Smith. One appendix gives general references to published material about related subjects and another appendix contains symbols and abbreviations. Prentice-Hall, Inc., New York, 1945; 216 pages, $4.00.

Book Notes

I Knew a Lad and Other War Poems, by J. Laurence Pritchard; privately printed for the author by The Lewes Press, Friars Walk, Lewes, 1945; 35 pages.

The Secretary of The Royal Aeronautical Society and editor of its *Journal* is an accomplished writer in other fields. In this privately printed booklet he gives his thoughts about the war in a series of poems. The dedication is to his son, a pilot officer who was killed in 1940.

Captain Pritchard reflects the spirit of the English people in the war with great imagination and idealistic poetic diction. In the poem, "Death of a Pilot," occurs the phrase "found sanctuary in the stars" which is typical of the idealistic quality of the lines found in his other poems.

Written out of the courage and fortitude of one who has suffered a great personal loss, the poems are more than the reflection of an onlooker; they are the inner voice of "the many by their courage who fought and saved their native land."

Two Hundred Thousand Flyers, by Willard Wiener; The Infantry Journal, Washington, 1945; 196 pages, $2.75.

The work done by the Army's Contract Pilot schools is described in this book as part of the Civilian-A.A.F. Pilot Training Program.

Starting with only the request of General Arnold that seven of the existing pilot training schools prepare to train a large number of pilots, these and other schools supplemented the training given at Randolph Field and made it possible for the A.A.F. to have 110,000 pilots trained in one year.

The story of how this was done and the records of some of the pilots who won fame and recognition is related in easily readable pages. An appendix gives a brief sketch of each of the schools that participated in this successful plan.

With production of aircraft receiving the principal emphasis in the minds of the public, this book should help to earn proper appreciation of the personnel problems solved by the Army Air Forces.

WACS at Work, by Fjeril Hess; The Macmillan Company, New York, 1945; 181 pages, $2.00.

The WACs are employed in a wide range of activities in the Army. This book limits the study to their work in the A.A.F. It follows through the training, the assignment, and the specialization of these young women at an airfield. In conversational style a clear picture is given of the mental reactions of the recruits to their new duties.

That the WACs have released thousands of men for more active duty is well known, but only when the numerous services they render are described can their contributions to the war effort be fully appreciated.

Youth at War, comprising **Fighter Pilot,** by Paul Richey; **Sub-Lieutenant,** by Ludovic Kennedy; **Infantry Officer,** by Anthony Irwin; B. T. Badsford Ltd., London, 1944; 212 pages, 15*s*.

Three books previously published separately are reprinted with a foreword by Admiral of the Fleet Lord Keyes. *Fighter Pilot* is a personal story of the action of the R.A.F. in France before Dunkirk. It gives a description of the fighting done by the poorly equipped and undermanned English air forces when the Germans started their invasion of France. A single fighter squadron composed of 15 young pilots destroyed 114 enemy aircraft in 9 days. Of equal interest are the impressions of the way an R.A.F. squadron lived under such difficult conditions.

Sub-Lieutenant is a narrative of the work of a junior officer of the Royal Navy. It contains a good account of the sinking of the "Bismarck" as viewed from a destroyer that took no active part in the battle but stood by while other ships and aircraft ran down and destroyed the German battleship. Another chapter describes a battle in the air, when German bombers were repulsed by the destroyer's antiaircraft guns and land-based fighters. *Infantry Officer* is a record of service with the ground forces.

The foreword by Admiral Keyes gives his views about the relative needs of sea, air, and ground forces.

Great Soldiers of World War II, by Major H. A. DeWeerd; W. W. Norton & Company, Inc., New York, 1944; 316 pages, $3.75.

Although this book, containing studies of the lives of political and military leaders, does not have biographic sketches of any Air Force officers, it does give much background material that is of interest in studying the development of air power.

In the preface the author states that the great work of General Arnold, Air Chief Marshal Harris, and other principal officers of the Allied air forces will not become fully apparent until the whole pattern of World War II is clear.

Theorie und Praxis der Schwingungspruefmaschinen (Theory and Practical Application of Vibration-Testing Machines), by Wilhelm Spaeth; Verlag von Julius Springer, Berlin, 1934; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 98 pages, $3.25.

In this two-part book the author endeavors to give a concise but exhaustive presentation of various problems relating to dynamic measurements. The first part treats the basic magnitudes of dynamics, their interrelations and measurements. Various problems that are encountered during the dynamic measurement of technical structures are discussed in detail. The comprehensive representation of forced vibrations receives special consideration and is explained by means of geometric relations. This geometric representation of the laws of vibration may be of interest to those who want to become quickly acquainted with the principal features of dynamic measurement.

In the second part, measurements and experiences in connection with special cases are described. Examples selected from various technical fields show how old and new problems may be more easily visualized by the application of forced vibrations in dynamic measurements.

Ten Summers, by John Pudney; John Lane the Bodley Head, London, 1944; 112 pages, 7*s*. 6*d*.

This collection of verse contains some of the poetry written by the author during the 10 years from 1933 to 1944. Commencing with 1940 the principal theme of the verses is flying and there follow about seventy short verses that have to do with airmen.

They Called It "Purple Heart Valley," text and photographs by Margaret Bourke-White; Simon and Schuster, New York, 1944; 182 pages, $3.00.

Miss Bourke-White's photography is world famous, and this book will be of equal interest as it adds to its fine pictorial quality the text of an observing and well-informed writer. She undertook the assignment to photograph the activities of the Italian front for *Life Magazine* with the approval of General Somervell.

The resulting book is a "sandwich" of grouped pictures and reading matter which gives a vivid idea of life under combat conditions. Many flights were made in Grasshopper Cubs and their utility is praised in glowing terms. The experiences of the author under fire give a close-up of battle conditions in the rugged terrain of southern Italy. The viewpoint of artillery forces is emphasized as they, with the air forces, prepared the way for forward movements. How the combination of ground, sea, and air forces brought success is clearly shown, but of even greater interest are the results of many questionings of the soldiers who were undergoing the hardships of the winter conditions under which the action was taking place. These spoke their minds freely and told of their hopes and frustrations.

THE BELL HELICOPTER

A new kind of flying

THOUSANDS *of inquiries demonstrate an enthusiastic interest in the new Bell Aircraft helicopters.*

One reason is that the helicopter provides a kind of flight we have always sought. In a helicopter, you can go straight up and down, you can hover, you can go sideways or backwards. All these things, impossible in a conventional airplane, can be done in a helicopter with safety and precision control.

And that accounts for the questions . . .

THE QUESTION OF WHEN . . . It is hard to draw a line between enthusiasm for the helicopter and realistic thinking on when helicopters will be available.

Bell Aircraft believes in the helicopter, believes in it as a practical aircraft, a safe aircraft, an aircraft with an important post-war future. We, too, are impressed by what it can do. In addition to its other advantages, for example, a helicopter doesn't need elaborate landing facilities and airports, and in "helicopter weather" with ceiling and visibility near zero, the helicopter can fly because of its ability to operate at low, safe speeds.

But the fact remains that helicopters, of the kind we expect to market, are not available now. Aside from the requirements of war work, which at Bell Aircraft come ahead of everything else, a lot of developmental work remains to be done.

And so it will be after the end of the war—say, a year or more—before Bell helicopters are available. But—helicopters *are* coming.

THE QUESTION OF COST . . . How much will a helicopter cost?

That depends on the kind and size of helicopter built, the volume of production and many other things.

The first Bell helicopters, however, will not be in the "low price car" field.

This means that the first helicopters will probably be sold to commercial and industrial concerns which have a need for them and which will find it economical to buy helicopters for business purposes. For such uses, the cost of the helicopter will be of less importance than its utility.

Low-priced helicopters will come—with mass production and further development.

ABOUT STABILITY . . . One of the most important characteristics of a helicopter is stability. The Bell Aircraft helicopter has it—engineered stability—through the use of a patented stabilizing bar which acts much like a gyroscope.

WHAT CAN YOU DO WITH A HELICOPTER? Bell Aircraft feels that the helicopter will develop through various stages.

First, it will be used by industrial concerns that need it and can afford maintenance facilities and professional pilots.

Second, the helicopter will get into other commercial channels when circumstances make it possible to use them more widely.

Third, and later on, the helicopter will be used by sportsmen pilots and others who want safe, dependable air travel regardless of terrain conditions and despite poor weather. And finally, helicopters will get into the general market.

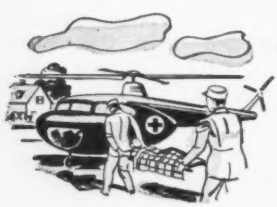
Bell Aircraft does not believe that the helicopter will compete with fixed-wing planes, but rather that it will open up a new and still untapped field of flying, a new dimension of flight.

AND IN CONCLUSION . . . We probably haven't answered all your questions. But we have tried to tell generally how helicopters work; what they can be used for; and how we think about them.

If you would like to know more, a booklet giving details regarding the Bell helicopter will be mailed without obligation. Write the Bell Aircraft Corporation, 2050 Elmwood Avenue, Buffalo 7, New York.

★ *Buy War Bonds and Speed Victory* ★

Specialized uses for the helicopter are many and varied. For example:



Suburban ambulance service

Commuter service

Forest fire control

Pipe line patrol

Coast Guard rescue work and disaster relief

Also for geological survey work, crop dusting, short hauls for mail, short hauls for commercial cargoes, department store rural deliveries, feeder lines for commercial air lines, mining work where the terrain makes access difficult, laying cables and wires, personal transport to and from places which lack air terminal facilities, and many other uses.

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BELL *Aircraft*

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Airacobra (P-39) and Kingcobra (P-63)—Fighters
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The Bell Helicopter

ORDNANCE DIVISION
Burlington, Vt.
Flexible Gun Mounts and other ordnance materials

GEORGIA DIVISION
Marietta, Ga.
B-29 Boeing Designed Superfortress

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Beitraege zur Ballistik und Technischen Physik (Contributions to Ballistics and Technical Physics), edited by Hubert Schardin; Verlag von Johann Ambrosius Barth, Leipzig, 1938; published and distributed in the public interest by authority of the U.S. Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 216 pages, $7.00.

This book was published to commemorate the 80th birthday of Carl Cranz, Professor of Ballistics at the Military Technical Academy at Berlin. It contains a compilation of articles written by a number of his pupils.

The titles and writers of the articles follow: "C. Cranz (A Brief Biography)," by Hubert Schardin; "Cranz and External Ballistics," by Otto V. Eberhard; "More Recent Italian Investigations on the Calculation of the Element of Arc of a Curve," by Dora Wehage; "Characteristics of the Ballistics of Bomb Dropping," by Hans Knobloch; "Sighting Instruments for Dropping Bombs During Horizontal Flight," by Wolfgang Mueller; "Contribution to the Construction of Artillery Projectiles," by Otto Luehr; "Ballistics at the Shooting Range," by Theodor Roszmann; "Measurement of the Initial Velocity of Projectiles by Means of the Coil-Boulenge," by Horst Lukanow; "Determination of the Velocity of Projectiles from Their Electrostatic Charge," by Heinrich Langweiler; "Some New Measuring Instruments Which Have a Short Measuring Base," by Walter Woehl; "Experimental Methods to Investigate, Test, and Develop Machine Guns," by Dietrich Kreidel; "Television Methods," by Hubert Schardin; "Consideration on the Development of Scanning Spots for Television," by Rudolf Zimmermann; "On Supersonic Waves, Observed When Projectiles Hit Armor Plate," by Eugen Maier; "On Producing High Numbers of Revolution, and Their Application in Physics and Ballistics," by Richard Emil Kutterer; "Nominal Function of the Resistance of Discs which Rotate at High Speed in Free Air," by Ernst Genning; "Supersonic Wind Tunnels and Ballistics," by Conrad Himmler; "Effect of Elastic and Plastic Pressure Loads on the Magnetization of Nickel," by Martin Kersten; "On a Standard Period of Time, Measured by Means of a Compensating Pendulum, Half an Oscillation of Which Lasts 0.2 Sec.," by Wolfgang Struth; "Technical-Physical Principles of Searchlight Construction," by Karl Brandmayer; "High Resistance Liquids for High Tension," by Walter Woehl.

Rigby's Easy to Build Models of Naval Craft, by Wallis Rigby; Garden City Publishing Company, Inc., New York, 1944; 27 pages, $1.19.

A book containing cardboard cutouts for the construction of 24 models of heavy and light warships, including aircraft carriers. Instructions for the assembly of these models are included.

Steam and Gas Turbines with a Supplement on the Prospects of the Thermal Prime Mover, by A. Stodola and Louis C. Lowenstein; Peter Smith, New York, 1945; Volume I, 763 pages, Volume II, 591 pages, set $20.

An English translation of the sixth German edition of an exhaustive work on steam and gas turbines. Some of the subjects discussed in the section on gas turbines include the theory of the gas turbine with perfect gases and constant specific heats; the gas turbine theory with the assumption of variable specific heats; the explosion turbine; the gas turbine with combustion at constant pressure; the exact values of gas entropy; some vital problems in the construction and operation of gas turbines; gas turbine types; and the centrifugal compressor.

Plastics, by H. Ronald Fleck; Chemical Publishing Company, Inc., Brooklyn, N.Y., 1945; 325 pages, $6.50.

Scientific and technologic aspects of the plastics industry are dealt with in this volume. The text comprises a critical survey of the published material on the subject and a correlation of scattered data. The author's intention has been to provide a book that will be of value to chemists of the plastic industry and to practical men whose work requires a knowledge of the chemistry and technology of plastics. New developments in plastic materials both in the United States and Europe are discussed in detail.

Aircraft of the Fighting Powers, compiled by H. J. Cooper and O. G. Thetford, edited by D. A. Russel; The Harborough Publishing Company, Ltd., Leicester, 1943; 76 pages, 21*s*.

The fourth annual edition of a book containing descriptions, illustrations, and three-view scale drawings of aircraft of the fighting nations. It deals with aircraft flown during 1943 by Great Britain, Canada, the United States, Germany, Japan, and the Soviet Union. Specifications, performance figures, weights, and the operational history of aircraft are given.

Brazil: Giant to the South, by Alice Rogers Hager, photographs by Jackie Martin; The Macmillan Company, New York, 1945; 80 pages, $2.00.

The story of Brazil is told in a closely related sequence of text and pictures. One section of the book, titled "Wagon Wheels and Wings," is devoted to transportation. The important part that aviation has played in Brazil's economic development is described.

Engineering Drawing, by Arthur Cryer; Sir Isaac Pitman & Sons, Ltd., London, 1944; 156 pages, 7*s*. 6*d*.

This is the fifth edition of a book on engineering drawing written especially for students in science classes, technical schools, and colleges. The initial examples are designed to overcome the student's difficulty in visualizing the objects he is called on to draw. Nearly all the examples are shadow lined, this method being used because, in the author's opinion, it improves the appearance of the drawings. Notes on the materials used in engineering have been rewritten.

Proceedings Georgia Aviation Clinic sponsored by Macon Chamber of Commerce, with County of Bibb and City of Macon cooperating; Macon Chamber of Commerce, Macon, Ga., 1944; 85 pages, $1.50.

A report is given of the transactions of the Georgia Aviation Clinic at meetings held October 3–4, 1944, at Macon. It describes activities directed toward the promotion and development of aviation in Georgia.

The Nocturnal Maximum Occurrence of Thunderstorms in the Midwestern States, by Lynn L. Means; Miscellaneous Reports No. 16, Department of Meteorology of the University of Chicago; University of Chicago Press, Chicago, 1944; 37 pages, $0.75.

Data and conclusions are given regarding nocturnal thunderstorms and factors bearing a causal relationship to the occurrence of a maximum of nocturnal thunderstorms at Omaha and in the surrounding regions. The first part of the paper is devoted to the occurrence of nocturnal thunderstorms, and the second part to instability caused by advection of warmer air in the lower layers of the atmosphere.

A Table of Mean Virtual Temperatures for the Air Column Between Sea Level and 10,000 Feet, prepared by Computing Staff of the Institute of Meteorology of the University of Chicago; University of Chicago Press, Chicago, 1944; 14 pages, $0.50.

A booklet of 14 pages contains a compilation of mean virtual temperatures for the air column between sea level and 10,000 ft. The use of the tables is explained in an introduction, with examples.

Civil Air Regulations for Pilot Certification; Aero Publishers, Los Angeles, 1944; various paging, $1.50.

Incorporated in this book are the Civil Air Regulations that students preparing for C.A.A. examination must learn, and the information required by members of the Armed Forces who are attempting to acquire C.A.A. certificates. The publication is constructed so as to allow late copies of C.A.R. parts to be inserted.

Theory and Applications of Electron Tubes, by Herbert J. Reich; McGraw-Hill Book Company, Inc., New York, 1944; 716 pages, $5.00.

The second and revised edition of a book written to provide the student with a sufficiently thorough grounding in the fundamental principles of electronic tubes and associated circuits to enable him to apply electron tubes to the solution of new problems. Important new developments of the past 5 years are set forth in this edition.

Vorlesungen Ueber Allgemeine Funktionentheorie und Elliptische Funktionen (Lectures on the General Theory of Functions and Elliptic Functions), by Adolf Hurwitz; edited and supplemented by a chapter on Geometrische Funktionentheorie (The Theory of Geometric Functions), by R. Courant; Verlag von Julius Springer, Berlin, 1929; published and distributed in the public interest by authority of the Alien Property Custodian by Interscience Publishers, Inc., New York, 1944; 534 pages, $7.50.

This book containing the lectures of the late Adolf Hurwitz is divided into two main sections and a supplement. The first section deals with the general theory of the analytic functions of a complex variable. This theory is based on arithmetical principles, according to the viewpoints of Weierstrass. The second section gives a concise, yet complete and clear introduction to the theory of elliptic functions, also based on Weierstrass's principles. It is stated, however, that the Weierstrass theory alone is no longer sufficient for modern application. Consequently, the author has added an introduction into Riemann's idea of the theory of geometric functions, this constituting an independent supplement.

Optische Pyrometrie (Optical Pyrometry), by Fritz Hoffman and Carl Tingwaldt; Friedr. Vieweg & Sohn, Braunschweig, 1938; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 134 pages, $3.60.

It is stated that in thermodynamics the laws of temperature radiation make it possible to continue the temperature scale far above that attainable by the use of the gas thermometer. In fact the scale may be extended, theoretically, to an unlimited height. The optic-pyrometric method is widely applied to scientific physical researches. However, according to the authors, an adequate criticism of the way these measurements are carried out and the results evaluated has hardly been attempted. They try to remedy this omission and in this book they present all the principal problems of optical pyrometry comprehensively without affecting its scientific aspect.

Seed of Chaos, by Vera Brittain; New Vision Publishing Company, London, 1944; 118 pages, 3*s.* 6*d.*

The purpose of this small book is to draw the attention of the British people to the effects of the type of bombing called "obliteration bombing" of civilians in enemy and enemy-occupied countries. The author quotes statements and figures from newspapers and other publications, and gives other information to show the extent of the destruction of life and property. A plea is made for the greatest possible restriction of that type of attack on the enemy and for the inclusion in any peace terms of agreements to refrain from such bombing in future wars. It is noted that the use of poison gas has been avoided by both sides in the present conflict and the belief is expressed that similar steps can be taken with respect to bombing of civilians.

An Introduction to Electronics, by Ralph G. Hudson; The Macmillan Company, New York, 1945; 97 pages, $3.00.

The author explains the science of electronics and its modern applications in terms that will be understandable to those with only an elementary knowledge of mathematics and physics. The modern theory of the constitution of matter is elucidated and a description is given of the nature of an electric current in a gas, a liquid, a solid, and a vacuum. Major uses of electronic tubes are described, and the construction of electronic devices and the principles on which they operate are explained. Among the instruments described is the radio altimeter.

Physically Handicapped Workers: I. Experience in War Industries; II. Rehabilitation of Veterans, by Ross A. McFarland; McGraw-Hill Book Company, New York, 1944; 31 pages.

In the first part of this study reprinted from the *Harvard Business Review* for Autumn, 1944, an outline is given of some of the results accomplished in the rehabilitation of physically and mentally handicapped workers in war production. The second part of the article is devoted to an analysis of what will happen when the veterans return to their former jobs with handicaps that may be even greater than the handicaps of those enlisted from the civilian population for war industry.

You Can Fly, by Capt. D. M. E. Marendaz; Bernards (Publishers), Limited, London, 1944; 49 pages, 2*s.*

A booklet in which simple instructions are given on how to fly an airplane. It tells the way to carry out various maneuvers and how and why an airplane flies. A brief history of flying is given in the first chapter. A glossary of aviation terms is included.

Engineering Mathematics, by Harry Sohon; D. Van Nostrand Company, Inc., New York, 1944; 278 pages, $3.50.

A text written especially for engineering students who have completed the study of elementary calculus and for graduate engineers who wish to increase their knowledge of mathematics. The author's object has been to present material that will strengthen the student's knowledge of algebra and provide him with certain mathematical tools that depend on calculus. Most of the topics covered made up the subject matter of a course taught by the author at Cornell University. Determinates and the matrix theory are used extensively.

(*Continued on page 115*)

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THE "GOONIE-BIRD" landed in rugged shape one afternoon . . . 2 engines out . . . another leaking oil . . . hydraulic system out . . . control cables half gone; two men eligible for the Purple Heart.

Then Casey took over, Casey the Crew Chief, and his gang of mechanics. They worked all that night . . . in a downpour. They didn't have any regulation block and tackle to dismount the engines. So they used a palm tree and a ship's hawser instead. And in 16 hours, they took out 3 engines; mounted 3 new ones; repaired the hydraulic system and installed new control cables. Then two of the mechanics flew as gunners in the Goonie-Bird, to replace the guys wounded yesterday.

Men like these mechanics have got inside them a great hunk of that special American brand of mechanical genius and ingenuity. They'll come home with a whale of a lot to contribute to the factories and airports of the nation; and quickly and permanently, men like these will establish America as the leader of the world in commercial aviation.

Handmaiden to a High-Powered Lady...

THOSE THREE NEW ENGINES *Casey installed may have been rust-proofed with Rust-Ban 604. The instruments, starters and hydraulic system parts of the Goonie-Bird may well have been rust-proofed with Rust-Bans. And so throughout the plane. With over 50 types of petroleum base Rust-Bans, originated and developed by Esso, there is a fine protective coating available for almost every type of bare metal under any atmospheric condition. Rust-Bans, widely used both in industry and by the Army and Navy, are further proof that "You can depend on Esso Aviation Products."*

YOU CAN DEPEND ON

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New, Portable Janitrol Aircraft Heater

The photograph above shows one of the models of the new line of Janitrol Portable Aircraft Heaters. This model has an output capacity of 40,000 Btu's per hour. The overall size is approximately 3 feet long and 1 foot square, weighs under 40 pounds. The fuel tank has a capacity for 8 hours of continuous heater operation. Fuel supply will last longer when heater is cycling.

The unit assembly consists of a tamper-proof stainless steel housing.

Unit is equipped with Fuel Pump and Relief Valve, Fuel Pressure Regulator, Fuel Filter, Magnetic Fuel Valve, Ignition Coil Box with high tension cable to spark plug, 210°-180° Adjustable Temperature Control (cycling switch), High Limit Switch, Delay Action Fan Switch, Signal Lamp with switch, Relay, Electrical Overload Circuit Breaker. Axial Flow Fan with ½ h. p. motor for 24 volts operation.

Data on other models with larger and smaller capacities is available.

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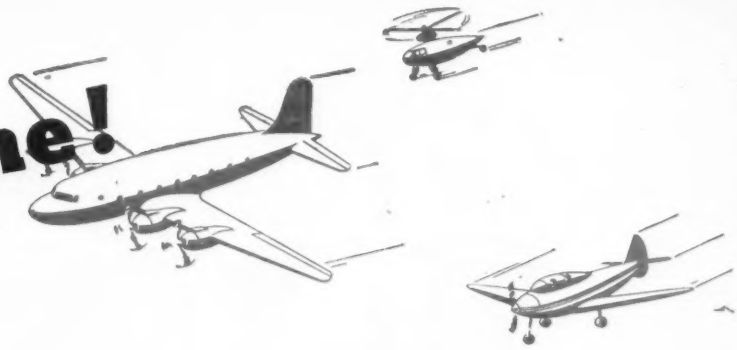


SECURE heater in position, plug it into an electrical outlet, run the exhaust out through the side of the plane. That's all there is to it. Now your plane has *heat . . . even if it wasn't originally designed to make provision for a heating system!*

These new Janitrol Portable Aircraft Heaters are completely self-contained units, designed for use up to 15,000 feet altitude. Each model is equipped with its own fuel tank, fuel pump, air fan and motor, and automatic controls. You don't have to build scoops for ram air on your plane, because both circulating and combustion air is taken from the interior of the plane. With a 40,000 Btu output capacity heater, you have at —65° F. outside temperature, heat equivalent to a ram-operated heater of 125,000 Btu's, because you don't have to heat up great volumes of incoming cold air. This means savings in heater size, weight, and fuel consumption. And you can have heat *on the ground* as well as in the air because Janitrol Portable Aircraft Heaters operate independently of plane engines.

Think of the Possibilities!

When you carry passengers you have comfortable heat. When you carry cargo you can *remove the heater* and use it for other purposes.

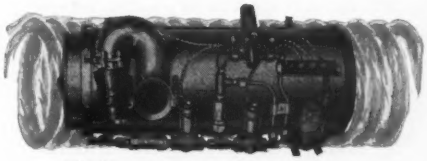
Your engine refuses to start in cold weather. You lift out your heater and direct a stream of warmed air around the engine.

You may operate a helicopter. Six-directional motion makes ram equipment unfeasible. With the right type and size of Janitrol Portable Aircraft Heater no plane motion nor ram air is needed.

Above all, your assurance of complete satisfaction is the fact that these Janitrol Heaters operate on the same exclusive *whirling flame* principle which has made Janitrol Aircraft Heating Equipment so outstandingly successful.

The development of new methods of heating and their application to many uses is one of the reasons why industry looks to Surface Combustion for progress in heating.

Our Engineering Staff is ready to discuss the application of Janitrol Aircraft Heaters for your requirements. For more information on the latest Janitrol developments, write Surface Combustion, Toledo 1, Ohio.



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"HEY, CUT IT OUT! Don't throw that water!" . . . Rough stuff in the rumpus room has frayed many a parent's nerves. But thanks to VINYLITE plastics, there's upholstery today that stays unfrayed through countless riots—and even keeps on *looking new!*

Tough stuff, this VINYLITE plastic upholstery! It wears as upholstery never wore before. Old age doesn't crack it. Grease can't affect it. You never have to worry about its soiling, for it is readily cleaned with a damp, soapy cloth. In short, upholstery fabric coated with VINYLITE plastic compound brings degrees of wear resistance, long life, and untroubled service never before attained. And it's a *quality* material, at home among the choicest textiles and the most discriminating surroundings. It can be produced in desired colors, in unusual surface effects, and with the rich texture of fine leathers.

Today, VINYLITE plastic upholstery is demonstrating its outstanding wear and toughness in jeeps, planes and tanks. In days to come it will take its place as the superlative material for home and office furniture, motor cars and motor boats, buses, and other peacetime applications.

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Waves in the Easterlies and the Polar Front in the Tropics, by Herbert Riehl; Miscellaneous Reports No. 17, Department of Meteorology of the University of Chicago; University of Chicago Press, Chicago, 1945; 79 pages, $1.25.

A report of a detailed investigation of the isallobaric centers that move across the Antilles and Caribbean areas during the hurricane season. Particular attention is given to the upper-air structure connected with these isallobaric centers. Sections of the paper deal with waves in the easterlies; the polar front in the tropics; the relation of the structure of the subtropical highs to wave motion in the tropics; and tropical storms in winter. A bibliography is included.

Physik und Technik der Haerte und Weiche (Physics and Technique of Hardness and Softness), by Wilhelm Spaeth; Verlag von Julius Springer, Berlin, 1940; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 250 pages, $7.00.

The author attempts to give a new conception of the term "hardness" by refuting conventional opinions. He raises the question whether it would not be better to replace the term "hardness" by its opposite and to establish ratings on the basis of softness, or at least to give the measurement of softness an equal place with hardness. It is stated that the term "hardness" takes a unique position in physics and in practical application. Inasmuch as the use of the term "hardness" is necessary in order to characterize a certain material, the attempt to determine theoretically or to indicate in practice the actual meaning of such a characterization meets with unexpected difficulties.

Press Tool Practice, by P. S. Houghton; Chapman & Hall Ltd., London, 1944; 341 pages, 21*s*.

This is a reprint of the second volume of a study of current press-tool practice in various industries, including the aircraft industry. Operations carried out under the press are discussed in detail. Other subjects dealt with include estimating, production planning, and tool recording. A chapter for the maker of press tools discusses the materials available for press-tool construction.

Problems of Scientific and Industrial Research; Oxford University Press, London, 1944; 64 pages, 2*s*.

This booklet was written for the purpose of focusing attention on those problems of industrial research which are most closely related to the development of fundamental science in the fields of physics, chemistry, and some parts of biology.

Alignment Charts, by Maurice Kraitchik; D. Van Nostrand Company, Inc., New York, 1944; 94 pages. $2.50.

An exposition is given of the methods and techniques involved in the construction of monograph charts of the type known as alignment charts. These are charts based on a combination of mathematical principles and draftsmanship for the representation in graphic form of mathematical laws. The first part of the book is devoted to a review of the mathematics required for an understanding of chart construction.

Air Compressors, by Eugene W. F. Feller; McGraw-Hill Book Company, Inc., New York, 1944; 460 pages, $4.50.

Written for production superintendents, operating engineers, and students, this book gives information about the various types and designs of air compressors, including the axial compressor used in gas turbines. Mechanical descriptions and operating explanations are included, and curves and diagrams show the working principles of the compressors.

Heat Engines, by A. C. Walshaw; Longmans, Green and Company, New York, 1944; 412 pages, $1.43.

The second edition of an introductory text for students preparing for first examinations in the subject of heat engines and applied thermodynamics. Fundamental principles are explained and information is given about their application to engineering problems. A portion of the text is devoted to the testing of heat engines and methods of analyzing and reporting the observations made.

Carrier War, by Lt. Oliver Jensen; Pocket Books, Inc., New York, 1945; 172 pages, $0.50.

The story of America's aircraft carriers is told in this biography of Task Force 58, from the start of the Pacific offensive to the present. While it is primarily an action story told in terms of people, dialogue, and accounts of air and sea battles, it is also a historical review of the Central Pacific campaign. The majority of the pictures shown are official Navy photographs.

Technische Oberflaechenkunde (The Science of Technical Surfaces), by Gustav Schmaltz; Verlag von Julius Springer, Berlin, 1936; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 286 pages, $15.

It is stated that the physicist considers contact surfaces to be of great importance while the engineer is inclined to regard the surfaces of construction parts as two-dimensional geometric forms. In this way the engineer is very often forced to disregard the special stress conditions near the surface and does not take into consideration that the structure near the surface of the majority of construction parts differs entirely from that of the center. Contrary to the conventional, purely geometric, view of the conception of surfaces of a material body, the author presents them as what they really are: thin material structures of a distinct form and of special properties.

The following cases are stated to be more or less dependent upon the microstructure of surfaces: alternating strength; friction between solids and intermediate liquid or gaseous layers; flow along rough walls; reflection of rays of any wave length; heat radiation of surfaces; transmission by conduction and convection from walls to fluids or gases at rest or in motion, etc.

With these general considerations in view, the author presents methods of investigating the microstructure of surfaces. Some of these procedures are quite recent. By means of the results of these investigations the engineer and designer are enabled to approach important problems that are related to the form and characteristics of surfaces.

The Weather Map; American Technical Society, Chicago, 1944; 54 pages, $0.60.

Airway Weather Service; American Technical Society, Chicago, 1944; 44 pages, $0.50.

Booklets No. 31 and 32 of a series on various phases of flight. Booklet No. 31 contains information about the making of weather maps. Sections are devoted to weather-station instruments; weather observations; weather-code figures and symbols; the making of a typical observation, and map analysis. A set of examination questions and answers is included.

Booklet No. 32 describes U.S. Airway Weather Service methods of furnishing meteorologic information for aviation. Sections discuss the purpose and organization of the service, airway weather reports, upper-air observations, and airway forecasts. A list of weather station call letters is given and examination questions and answers are provided.

Straight Up, by Henry B. Lent; The Macmillan Company, New York, 1944; 87 pages, $0.72.

Straight Down, by Henry B. Lent; The Macmillan Company, New York, 1944; 96 pages, $0.72.

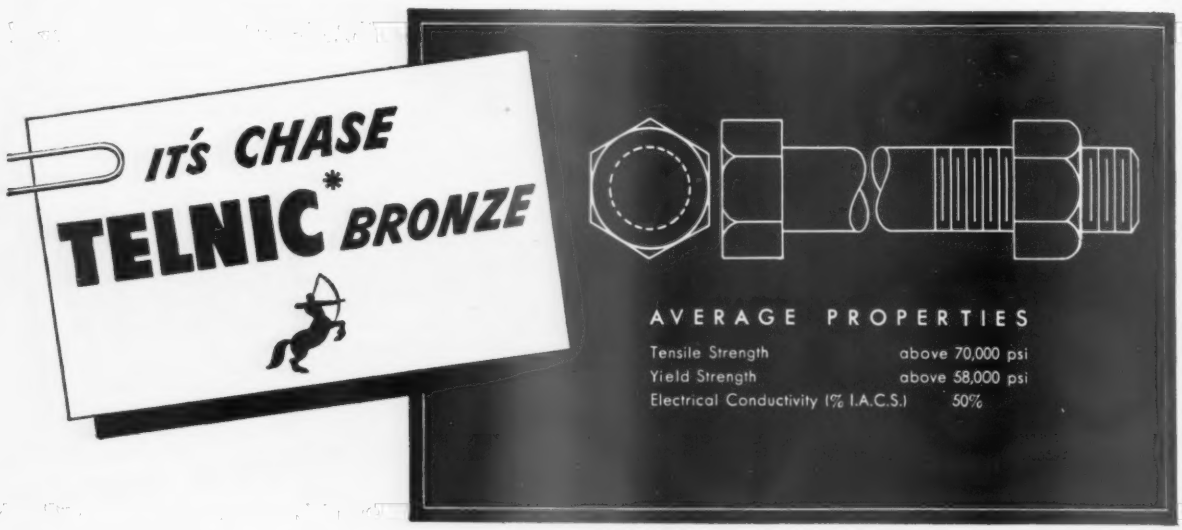
Two books in the Aviation Readers series for children. In language and terms comprehensible to youngsters in the primary grades, the first describes the principles, operation, and potentialities of the helicopter; the second, those of the parachute. Supplementary vocabularies are included with each primer.

Stock Control and Storekeeping; British Standards Institution, London, 1944; 25 pages, 2*s*.

The general principles of stock control and storekeeping are set forth in this booklet. While the principles explained are applicable to all industrial undertakings, the book has been written especially to aid the smaller company. It contains recommended procedures for the various departments concerned and for the organization of the clerical system. An explanatory flow chart is included. An appendix contains hints and points on the training of a staff for stores work.

There's a NEW

MATERIAL FOR PARTS LIKE THIS...



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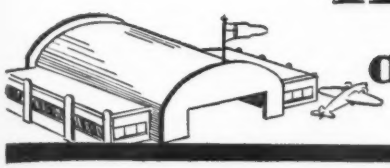

Dies for Aircraft Production

Time Versus Production. Eugene E. James. This is a description of how "pan cake" dies designated as type "D" have enabled the Lockheed Aircraft Corporation to produce tools and blanked and pierced aircraft parts in approximately one-third the time required with conventional die methods. The method of making the "D" die is described, and an outline of how it is assembled is given. *Steel Horizons*, Vol. 7, No. 1.

Precision Measuring Methods

Quality Control. This pocket-size handbook explains scientific inspection through controls offered by precision measuring instruments. Information regarding precision measuring methods is provided in charts, tables of measuring data, and conversion tables. Precision instruments are described and methods of using them are explained.

Among the precision instruments shown are mobile inspection units, sine bars, vernier gages, optical flats, and comparator gages. Thirty-five key questions are intended to serve as a check on the knowledge acquired by the reader. *Continental Machines, Inc.*, Minneapolis.

Color-Selection Guide

A Practical Guide to the Use of the Optonic Color System is intended to enable persons without detailed technical understanding of color science to specify correct color shades that minimize fatigue and promote safety. Developed for use in industrial, commercial, and institutional interiors, the method facilitates the selection of colors for a painting job on a scientific basis to insure the maximum benefits obtainable through the use of color. It has reduced the answers to the usual color-selection problems to 18 short rules. These rules relate directly to the colors in the "Optonic" system, including five shades of accurately measured reflection value in each of five colors—blue, green, tan, coral, and gray—but they apply to all color selection work.

The first eight rules specify the use of colors to compensate for deficiencies in natural and artificial light limited by the direction of window exposure and the type of electric lamps used. The remaining rules guide the choice of shades for work areas, machinery, and building equipment on the basis of measured contrasts and reflection value, as well as the selection of more colorful combinations for areas where contrast with prevailing plant colors encourages relaxation and relieves fatigue. The 25 shades have all been selected in accordance with the Ostwald System and the Weber-Fechner Law of visual intensities and can be used in any combination.

Color Power for Industry is a ring-bound booklet that contains explanations of the "Optonic" system and its application. *The Arco Company*, Cleveland.

"It Flies Like an Airplane"

Advanced Trainer Model Unveiled at Link Plant. Data about the constructional and operational features of the device are included in this announcement of a new Link Trainer. Designed for advanced instrument flight training, the new model includes a new air-loaded control system, trim-tab controls, engine instruments and their controls, and built-in longitudinal lateral and directional stability. Its handling in operation is said to be similar to that of an Army AT-6 or a Navy SNJ. *The Connecting Link*, February, 1945.

Thermostatic Controls

Thermostatic Controls. Designated as B-3344, this catalog contains descriptions, specifications, and illustrations of thermostats for the accurate, automatic control of temperatures up to 650°F. *Westinghouse Electric & Manufacturing Company.*

Improved Methods Group

Short-Cut Specialists. Cliff Solomon. The functions, working methods, and achievements of the Job Improvement group at the Texas plant of North American Aviation, Inc., are reported. It is the responsibility of this group to analyze the various operations of a particular job and to recommend procedures and tools that will facilitate that job.

Their work falls into five major categories: provide minor holding devices where required; improve the working area, whenever feasible, by making parts or tools more accessible to the worker; improve operators' methods through instruction; show operators how they can utilize machine time to advantage for other work; and substitute power tools for hand tools when practical. They also watch for any unnecessary operation that can be eliminated. Innovations made by this group are noted, together with time saved by each. *Skyline*, January-February, 1945.

Screw Threads for Aircraft Applications

Bulletin No. 239 gives a condensed description of "Heli-Coil" inserts and the "Aero-Thread" screw-thread system. It includes elementary engineering data, brief statements of the advantages of these two designs, typical applications of both, and material on the tools needed for installation. *Aircraft Screw Products Company, Inc.*, Long Island City, N.Y.

"In the Service of His Country"

Brigadier General Frederick Walker Castle. R. E. Gillmor. A testimonial to the late Brigadier General Castle, former Assistant to the President of the Sperry Gyroscope Company, Inc. Preceded by a brief account of his early career beginning with his graduation from West Point through his affiliation with Sperry, this is a record of his service to the Army. It tells of the commands he held, the missions he performed, his promotions, and the honors he won. *Sperryscope*, January, 1945.

Service Manual

Service Manual No. 44-C describes the various applications of the Camloc Fastener 4002 Series. Cartoons illustrate the exact procedure to be followed in replacing any type of fastener damaged in service. A maintenance parts list is included. *Camloc Fastener Corporation*, New York.

Maintenance Welding

A "Miracle" Welding Process for Maintenance. Concentrating on the problems that concern maintenance, this 6-page folder offers pertinent data on low-temperature welding rods. It describes company procedures in which rods, applied at low temperatures to cast iron, steel, aluminum, bronze, etc., produce strong bonds while leaving the welded part easily machinable and the strength of the machined part unimpaired. There are suggestions for salvaging parts through these maintenance welding methods. *Eutectic Welding Alloys Company*, New York.

Research on 150-250 Hp. Engines

Ranger Begins Engine-Prop Tests. Some notes on the tests that are being conducted by Ranger Aircraft Engines

Division for design data on efficient engine-propeller combinations for engines of from 150 to 250 hp. Included in the information about the equipment being used are details about a screen grid and movie camera that records the flight path of the aircraft throughout the entire test, producing a graphlike record for the evaluation of propeller efficiencies. *The Pegasus*, March, 1945.

Blast-Cleaning Problems

Blast Cleaning Specials is the title of a booklet describing 21 unusual problems in blast cleaning that required special equipment for production handling. One of these problems was the cleaning of aircraft propeller subassembly parts involving specified portions of many odd shapes. The machine designed to carry out this work on a continuous and automatic production basis is illustrated. *Pangborn Corporation*, Hagerstown, Md.

Reprocessing Used Oil

New Oils for Old. Bell Aircraft Company's system of reclaiming used oil is described. In an outline of the procedures to which the used oil is submitted until it is rejuvenated, comments are included about the refinery equipment employed. *The Bellringer*, February, 1945.

Ball Bearings Standards

Ball and Roller Bearing Standard Specification. Standard specification data on the manufacture of ball and roller bearings are contained in this manual. Prepared for the purpose of eliminating separate specifications, the data pertain to types of bearings, a uniform basic part numbering system, standardized workmanship, inspection, and tests. A form of tabulated dimensional data is included. *Anti-Friction Bearing Manufacturers Association, Inc.*, New York.

Theme for Air-Travel Subscribers

Air Travel Plan. An interpretation of American Airlines' Universal Air Travel Plan. The evolution of this sales plan and the extension of its conveniences for air travelers are traced from its origination in 1932. The claim is made that, although the 15 per cent discount privilege has been discontinued temporarily, the plan retains its popularity because of other advantages that it offers. *Flagship World*, January-February, 1945.

Magnesium Alloys

Who? What? When? Where? Why? A booklet has been published about Dowmetal magnesium alloys and their uses. Seventy-three typical applications of Dowmetal for aircraft parts are listed. A diagram shows how magnesium is extracted from sea water. *The Dow Chemical Company*, Midland, Mich.

Invented by Employees

Gadgetry. A group of photographs illustrates original devices used at the North American Aviation, Inc., plants at the suggestion of employees. The equipment surveyed includes a device for inflating tubing through which wire can be passed; an attachment that makes a portable manual drill press out of a hand drill; a recharger for dry cells; a transparent, Plexiglas test part; a meter for measuring spooled wire; apparatus that simplifies the making of junction boxes; and a magnetic pickup for small parts. *Skyline*, January-February, 1945.

Growth of a Manufacturing Company

The Evolution of an Enterprise. This pamphlet traces the evolution of the Pryor Manufacturing Company, recording the company's development from predecessor companies. In brief terms it describes the products manufactured by the firm and tells of the facilities offered. Particular attention is called to the development work done on die castings and to current production on the new Di-Forge casting machine. The predecessor companies whose operations and products are noted are the Carter-Barnes Pump Company, Carter-Pryor Manufacturing Company, and Mansfield Precision Castings. *Pryor Manufacturing Company*, Mansfield, Ohio.

Southern City's Aviation Possibilities

Jacksonville Florida . . . Center of Aviation in the Southeast. An illustrated booklet depicting the advantages possessed by Jacksonville, Fla., for the establishment of aviation business. Among the facilities discussed are the city's geographic location, skilled labor supply, distribution and transportation facilities, manufacturing sites, banking facilities, and climate. Part of the pamphlet is devoted to descriptive details about the naval and military flying operations already established in and around Jacksonville. *Jacksonville Chamber of Commerce*, Jacksonville, Fla.

Two Executives of Stratos Corporation

French Scientists Head Stratos Research. A biographic article written about Andre E. P. Planiol and Charles Bernard Brull, Vice President and General Manager, respectively, of Stratos Corporation. The careers of these two French scientists are traced from the time of the first World War to their present research and development work on high-altitude superchargers for the Fairchild affiliate. *The Pegasus*, March, 1945.

Velocity Modulation Tubes

Klystron Technical Manual. A manual has been issued describing the underlying principles of velocity modulation tubes. It deals particularly with the types known as Klystrons, which are used for converting d.c. energy into radio-frequency energy. The book has been prepared to provide in unified form information previously available only

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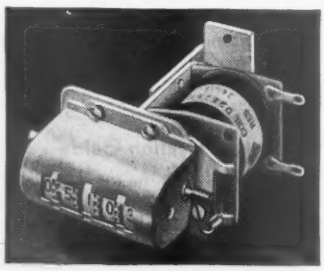

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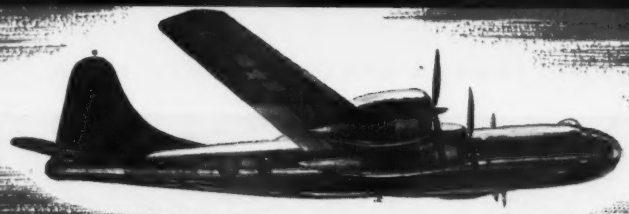

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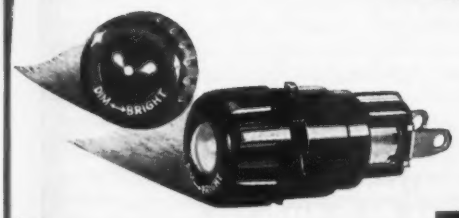
STANDAIR C-4A Cockpit Lamp Assembly. Specification 94-32294-C; S.A. 4297-D. Wt. 11 oz., overall length 5 5/16", diam. 1 3/4".



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The new STANDAIR C-4A Cockpit Lamp Assembly, with chain lock filter and retractable cord, is used as an auxiliary light source on all types of aircraft. Both the C-4A and its companion product, the STANDAIR Warning Light are made to meet the latest U. S. Army Air Forces specifications.

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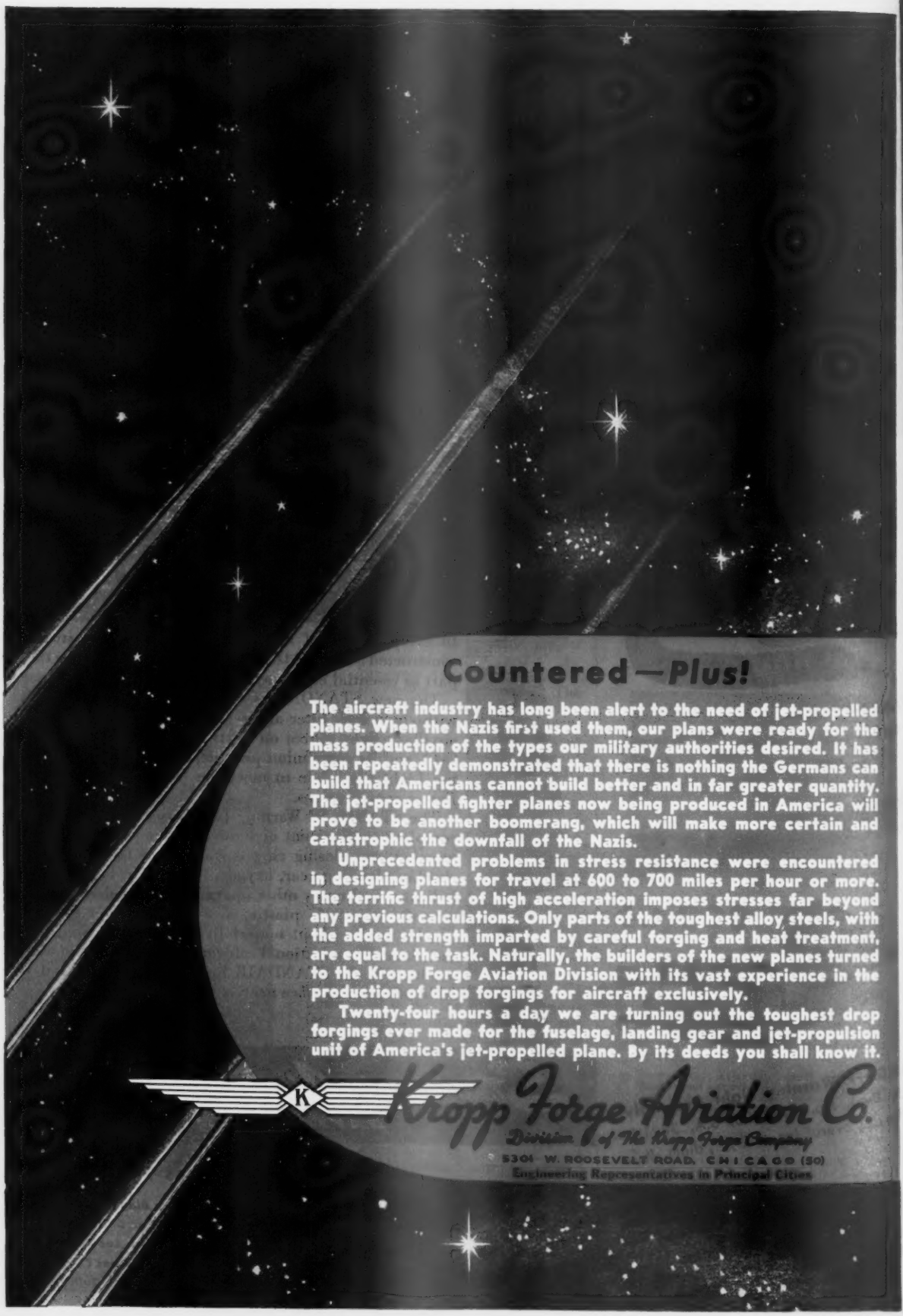
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The aircraft industry has long been alert to the need of jet-propelled planes. When the Nazis first used them, our plans were ready for the mass production of the types our military authorities desired. It has been repeatedly demonstrated that there is nothing the Germans can build that Americans cannot build better and in far greater quantity. The jet-propelled fighter planes now being produced in America will prove to be another boomerang, which will make more certain and catastrophic the downfall of the Nazis.
Unprecedented problems in stress resistance were encountered in designing planes for travel at 600 to 700 miles per hour or more. The terrific thrust of high acceleration imposes stresses far beyond any previous calculations. Only parts of the toughest alloy steels, with the added strength imparted by careful forging and heat treatment, are equal to the task. Naturally, the builders of the new planes turned to the Kropp Forge Aviation Division with its vast experience in the production of drop forgings for aircraft exclusively.
Twenty-four hours a day we are turning out the toughest drop forgings ever made for the fuselage, landing gear and jet-propulsion unit of America's jet-propelled plane. By its deeds you shall know it.
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in various articles in scientific journals. The manual is intended for the use of those who have an understanding of electronic phenomena. *Sperry Gyroscope Company, Inc.*

Solutions of Control-Equipment Problems

Lear Know How is a colored booklet describing and illustrating the facilities and products of a manufacturer of a wide variety of control equipment for aircraft and other applications. The description of each class of equipment is given under uniform headings comprising (1) the problem, (2) the "Know How" solution, and (3) the practical applications of the device. In this manner, information is included about linear and rotary actuators and power units, electric motors, electromagnetic clutches, flexible power shafting and accessories, screw jacks, automatic and remote controls, precision gears, and aircraft radio equipment. Other pages contain illustrations of the maker's quality-control and testing facilities and forecasts of postwar developments in various industries. *Lear Incorporated*, Piqua, Ohio.

Designing for Air Transportation

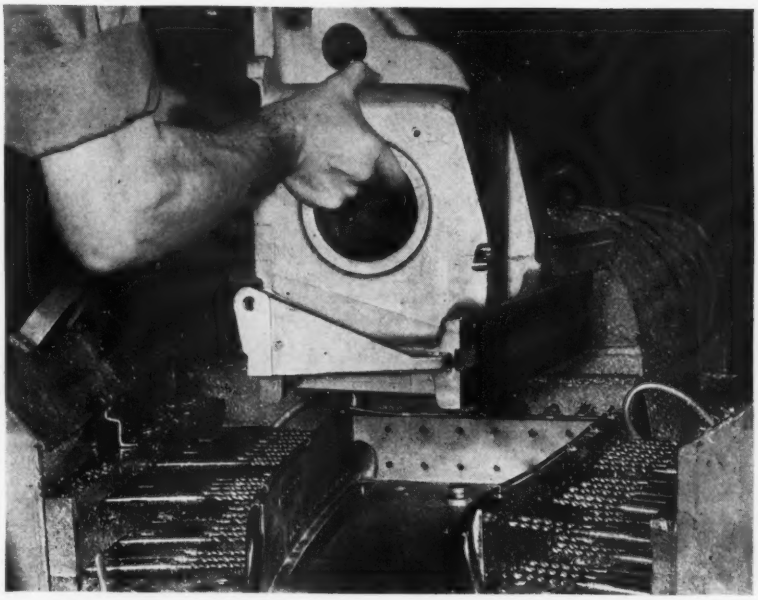
A New Design Approach to Airborne Operations. Richard S. Boutelle. This article deals with the importance of reciprocal design attention between designers of transport aircraft and designers of transport equipment and weapons. The writer discusses why the aircraft designer must design with the special size and weight requirements of ordnance and ground transport equipment in mind, while the equipment and weapons designers—guided by the fact that the cargo is destined to be carried by air—must aim for reductions in the size and weight of their products. The Fairchild C-82 Packet is cited as an example of a cargo plane that has been designed specifically to fit the weight, size, and other demands of transporting existing ordnance and transport equipment. *The Pegasus*, March, 1945.

Technical Notes on Glues

Aerolite & Aerodux Glues is a technical bulletin of 20 pages. It gives a general review of the properties and applications of these glues and certain hardeners, followed by specific technical data referring to the preparation, use, and characteristics of assembly glues and plywood glues. The text matter is supplemented by tabulated figures and drawings. *Bulletin No. 25*, January, 1945, *Aero Research Limited*, Duxford, Cambridge, England.

Instrument Catalogs

Numbered *15-35*, *15-36*, *15-37*, and *15-38*, four new catalogs have been issued by the Sperry Gyroscope Company, Inc. The first contains descriptive data and specifications on the company's gyro horizons and accessory equipment; the second, on directional gyros and accessory equipment; the third, on the attitude gyro and accessories; and the fourth, on the gyrosyn compass and accessories. Photographs and schematic drawings illustrate the texts. *Sperry Gyroscope Company, Inc.*



An example of ingenious tooling is the horizontal multiple drill conceived and developed by North American Aviation employees at the Texas plant. The drill does precision drilling of 69 holes simultaneously on three sides of the flange of a magnesium-alloy casting, a vital part of the P-51 Mustang landing gear.

Machines Facilitate Production

Tooling Innovations. A review of time- and labor-saving machines and methods instituted at the plants of North American Aviation, Inc. The information pertains to a horizontal multiple drill arrangement for landing-gear casting; a series of loading tables used in connection with a 5,000-ton capacity hydraulic press; an exceptionally small stretching machine; a sliding drill-press table for drilling landing-gear struts, engine mounts, and other long parts; an air-operated rivet-shooting attachment for automatic riveters; and a special grinder for manufacturing and reconditioning router bits and tempered reamers. *Skyline*, January-February, 1945.

Welding Equipment

Victor Gas Welding and Cutting Apparatus Catalog. A new 104-page catalog on Victor welding equipment is designated as Form 23. It contains descriptions, specifications, and illustrations of gas-welding and flame-cutting apparatus. Information about how to choose the unit best suited to particular welding requirements is also supplied. *Victor Equipment Company*, San Francisco.

Postwar Transport Plane

The Curtiss Commando is the title of an illustrated brochure telling the story of the Commando's performance in military operations and describing the postwar commercial version of this aircraft. Factors influencing the design of the plane are discussed. The interior design of the cabin, in which considerations were given to passenger comfort and luxury, is described. Particulars are given about cargo accommodations. Features of the instrument panel, cabin illumination, communications and control equipment are illustrated. *Curtiss-Wright Corporation.*

Fabricating Wing Parts

There's More to a Wing Than a Prayer. This group of notes tells something about the procedures employed by Bell Aircraft Company in the fabrication and assembly of wing center sections for the B-29. The working methods of the bulkhead assembly section as well as the sections responsible for the building of the top and bottom wing panels are discussed. *The Bellringer*, February, 1945.

Lubrication of Aircraft Engines

Aircraft Engine Lubrication. Information about aircraft greases and the lubrication of accessories has been added to the latest edition of a 52-page brochure devoted to the lubrication of airplane engines. The oil-circulating systems of the Wright Cyclone, Allison, Packard-built Rolls-Royce, and Pratt & Whitney engines are described in detail, with the aid of charts. Information regarding the general design of aircraft engines is also supplied. A chart shows altitude engine performance at standard altitude temperatures and pressures.

Subjects discussed in the added section include types of aircraft greases, their composition and lubricating characteristics, the manufacture and testing of the greases, and the applica-

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PRESTIGE ESTABLISHED IN THOUSANDS OF COMBAT MISSIONS!

Champion Ceramic Aircraft Spark Plugs are setting outstanding records for performance and dependability in the service of our air forces—from pilot training through to ultimate combat missions. That's why Champions have been supplied in ever increasing quantities to the air forces for four years past. Leading air line operators have likewise increased their demand for Champions because of their outstanding efficiency, economy and dependability. This prestige established in gruelling wartime service is a guarantee of Champion's continuing better performance and dependability after Victory. Use Champions and Fly with Confidence. Champion Spark Plug Company, Toledo 1, Ohio.

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tion of grease lubricants in aircraft-engine lubrication. *Sinclair Refining Company*, New York.

Hangar Doors

Robertson Vertical Lift Doors. In this illustrated pamphlet on vertical lift doors, the use of these doors for aircraft hangars is featured. Informative details are given relative to the principles upon which the action of the doors is based; the design and dimensions of the doors; their merits; and typical applications. *The H. H. Robertson Company*, Pittsburgh.

Shear Tests for Plywood

The Effect of Open Joints Upon Shearing Properties of Aircraft Plywood. O. H. Basquin. A report is made of a study undertaken to determine in a preliminary way the effect of open-edge joints upon the shearing properties of certain aircraft plywoods. The report opens with an explanation of the purpose of the study, describes the specimens and the apparatus used in the tests, and gives tabulations showing the details of the results. It is concluded that specimens whose directions of grain are parallel to their marginal loading bars fail by shearing fracture. Since adjacent plies have directions of grain that are at right angles, such shearing fracture must be parallel to the grain in some plies and at right angles to the grain in other plies. The tests suggest that shearing fracture across the grain takes a larger stress per square inch in the plies in which it occurs than does shearing fracture along the grain. This appears to account for the circumstance that in such specimens the per cent of reduction in shearing strength attributable to open joints is distinctly smaller than the per cent of reduction in net section caused by those open joints. *Engineering Bulletin* of Haskelite Manufacturing Corporation, Grand Rapids, Mich., Vol. 2, No. 2.

Revised Catalog Pages

Aircraft Products Catalog. Pages 9B to 16 inclusive, of the Mechanical Goods Section, Aircraft Products Catalog, have been revised and new pages issued. The replacements give catalog information about compressible air ducts, nonmetallic fittings for air ducts, multiflex air ducts, couplings, tubes, extensible defroster tubes, boots, control seals, bellows, chutes for ejected machine gun shells, landing gear dust-excluder boots, and rubber mountings. *U.S. Rubber Company.*

School for Women Pilots

The Resident Flight School for Young Women. Information about a resident flight school for women is contained in this illustrated booklet. Details are given about the organization of the Alabama Institute of Aeronautics, its location, and its facilities. A description of the courses is included, together with data pertaining to the school's requirements and fees. *Alabama Institute of Aeronautics*, Tuscaloosa, Ala.

Production and Maintenance Suggestions

Flagship World, January–February, 1945. (1) Combination tensiometer and point aligner for vibrator contact points on Mallory vibrators results in improved job and effects a saving of man-hours; (2) improvement on Link Trainer equipment results in a 40 per cent saving in Link Trainer time and facilitates types of instruction not previously possible; (3) revised procedure for installing carburetor-heater muffs; (4) deicer lines on C-54 carburetor air-scoop adaptors are tested by placing them in a tank of water and connecting an air hose to the inlet deicer fitting; (5) special jig reduces by half the time necessary to install new cups on pistons for duo-servo brake assemblies; (6) jig for aligning and drilling holes in landing-light reflector effects saving of $^3/_4$-hour per unit.

Douglas Airview, January, 1945. (1) Drill jig for radio table assembly results in greater accuracy in the locating and drilling of holes previously done by hand and also effects saving of man-hours; (2) method of manufacturing hinges on the power brake eliminates straightening operation, improves quality, and saves man-hours; (3) revision of wing-flap panel to prevent unequal leakage of the selector valve improves control of flaps as well as aerodynamic characteristics of the plane; (4) electrical hand-control unit for Erco machines results in a saving of man-hours; (5) stand for holding cross ties eliminates safety hazard, facilitates inspection, and saves man-hours; (6) fixture for quickly locating longerons at proper stations results in improved accuracy and a saving of time; (7) special fixture for routing narrow parts improves quality and eliminates rework; (8) clamp fixture for use in installation of cable deflector holds work in position accurately and effects a time economy; (9) hat-former clamps for use in nose assembly result in greater accuracy and man-hours saving; (10) tube-beading machine eliminates one of two operations and enables women employees to do a job with greater ease in less time; (11) fixture to roll out weights and pulleys for flight-control cables saves time; (12) special hold-down clamp for attach angles on wing-spar jigs results in easier method, assures accuracy, and eliminates scrapping material; (13) plate template for locating, drilling, and riveting on splices; (14) use of squeeze gun to rivet longerons to stations eliminates bucker; (15) improved tooling and new method of locating nut plates on Capital Purchase No. 219 machine; (16) improved hat-section clamp to hold section on panel jigs; (17) stationary jigs for the preassembly of parts in fuselage top section of airplane eliminates two framing and skinning operations, as well as four positions from the line, and also saves man-hours.

The Consolidated Vultee Eagle, January 26, 1945. (1) Attachment for draining fuel cells; (2) combination locating and welding jig for throttle and mixing-control brackets; (3) die polishing and grinding marker tool; (4) special drill press to drill two holes in a forging.

Douglas Long Beach Airview News, January 30, 1945. (1) Casters on nacelle stands save 6 man-hours daily; (2) punch-press degree fixture for wing chords; (3) hold-down strip for router blocks; (4) wedge for holding wing spar.

The Consolidated Vultee Volunteer, February 9, 1945. Reworking of a small ratchet enables tightening from the outside of nuts that are located at the joints of an airplane's horizontal and vertical stabilizer.

North Ameri-Kansan, February 9, 1945. (1) Method of reworking discontinued Plexiglas parts of bombardier's compartment; (2) tolerance attachment for router jigs.

Republic Aviation News, February 17, 1945. (1) Apparatus for calibrating the main fuel-tank liquidometer saves 99 min. per plane and necessitates the labor of one man instead of two; (2) addition of a Micarta guard on a wing rib angle assembly prevents damage to the hydraulic lines during installation; (3) use of scrap materials instead of oil adhesive tape to make the covers for the open ends of high-pressure ducts permits a timesaving of 15 min. per plane.

Laister-Kauffmann Glider Release, January, 1945. (1) Computer for balancing glider control surfaces before they are covered and doped; (2) method of applying tail zippers eliminates costly replacements.

North American Aviation Take-Off, February 16, 1945. Improved method of milling inside surfaces of flanges on wing brackets reduces by 60 per cent the time required for the job.

North Ameri-Kansan, February 16, 1945. Method of testing hydraulic and instrument lines under sustained pressure.

The Consolidated Vultee Volunteer, February 2, 1945. Method for facilitating removal of broken drills from gear drill spindle.

Oklahoma City Douglas Airview News, February 3, 1945. Idea to locate and mount station boxes for interphone system in their exact location on the boards before they are placed inside the plane effects an estimated saving of 30 man-hours for each plane.

North Ameri-Kansan, February 2, 1945. Scaled adjustment gage for heat-riser valve-control cables indicates the degrees of swing to any position of the valve and necessitates the attention of only one operator.

Jahco News, February, 1945. Method of making welded punch for dies saves labor, material, and time.

North American Skywriter, February 2, 1945. Grooved dies for 35-ton stretcher and Erco press; (2) combined bomb-rack fairing dies.

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GOODYEAR

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ON every fighting front in this war pilots and crew members, manning every type of military airplane, have proved the vital need for specialized seating equipment as designed and built by the Warren McArthur Corporation. Superior in strength and precision, yet exceedingly light in weight, these seats of aluminum and magnesium are designed for specific use, adjustable to immediate combat requirements. They have protected and improved the efficiency of the human factor . . the "brains of the planes" . . reduced the hazards of long flight fatigue . . thus helping to shorten the war.

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Noorduyn Tale-Spin, February, 1945. (1) Lining up leading edge and front spar saves time and material; (2) danger hazards eliminated on punch press; (3) key makes squeezer faster and easier to work; (4) improved locating jig for drilling holes on ailerons.

Tulsa Douglas Airview News, February 9, 1945. (1) Box-dumping rig for loading scrap into trucks from large scrap boxes; (2) connector and hanger for chrome-plating parts.

The Northrop News, January 31, 1945. (1) Pointer-and-compass-rose combination tool facilitates rigging and synchronization of propeller governor controls, effects a substantial economy in man-hours, and saves about 80 gal. of gasoline per airplane; (2) method of reclaiming rejected cowl baffle seals saves synthetic rubber seals; (3) idea for the origin and development of mill fixtures permits more accurate trimming of small tubing structures.

Eastern Aircraftsman, February, 1945. (1) Mold-line scriber insures accuracy and efficiency in addition to saved time; (2) aligning fixture eliminates the use of several small straight edges and numerous clamps and expedites the operation of aligning the wing assembly; (3) method of dimpling brackets and hood skins on the gill and fire-wall assembly saves time and eliminates the use of a very perishable tool; (4) new method of reworking ribs.

Santa Monica Douglas Airview News, February 6, 1945. Improvement in the design of the carburetor air-scoop mounting facilitates assembly.

El Segundo Douglas Airview News, February 13, 1945. (1) Indicator for grinder to set countersink properly prior to sharpening; (2) jig to hold cables of the Olsen tester; (3) clip clamp used on framing operation of wing flap.

(*Continued from page 93*)

Warfare

The Use of Airborne Troops. Major F. A. de V. Robertson. This article emphasizes the importance of reserving air-borne troops, whenever possible, for the specialized work for which they have been trained. It questions the wisdom of decimating such highly trained forces by having them do the work of regular infantry or other ordinary line regiments. *Flight*, January 18, 1945, page 76.

Airborne Lifeboats. The British development of an idea for dropping a fully provisioned, powered lifeboat to "ditched" air crews is recorded. Details are given about the construction of the boat; the modifications made on the Vickers Warwick to accommodate the installation of the boat; the parachute arrangement which provides for the safe descent of the boat to the water; and the supplies with which the boat is equipped. *Flight*, January 18, 1945, pages 62–64, 10 illus.

Welding

Safety Factors in Arc Welding. R. F. Wyer. The writer discusses safety factors in arc welding from the electrical point of view. The hazard of electric shock is considered in detail. Safety precautions for arc welders are listed. It is concluded that arc welding is not a hazardous occupation and that electric shock is a relatively infrequent cause of death. Where electrocution of the welding operators occurs, one or more of the following factors are usually involved: (1) an uninsulated electrode holder; (2) wet gloves and clothing; (3) a fall. *The Welding Journal*, February, 1945, pages 146–150, 11 illus.

Causes and Prevention of Defects in Welding. Frederick S. Dever. The various defects encountered in arc, gas, atomic-hydrogen, and spot welding are listed and discussed. Techniques and procedures that will ensure good welds are suggested. Brief information is given about an automatic atomic-hydrogen welding machine designed and built by Ryan Aeronautical Company to step up production rates and improve welded joints. Illustrations show proper and improper welding methods. *Product Engineering*, February, 1945, pages 121–124, 6 illus.

Aluminum Spot Welding Tips. Eugene J. Peltier. Some factors in aluminum spot welding requiring special analysis are considered. The application of equipment, formerly used for spot-welding steel, to the duties of spot-welding aluminum is discussed. Points to be considered when new equipment is purchased are also discussed. Information is given regarding welding techniques and the maintenance of welding equipment. *The Welding Journal*, February, 1945, pages 151–153.

The Welding of Non-Ferrous Metals. E. G. West. This is the first of a series of articles on welding procedures as applied to the various nonferrous metals and alloys. Reference is made to the difficulty of precisely or quantitatively defining the weldability of a metal or alloy. The essential differences between fusion and pressure welding are summarized, and the special techniques required for the welding of nonferrous metals are discussed. Consideration is given to the physical, mechanical, chemical, and metallurgic properties of nonferrous metals which govern to a large extent the choice of the welding process. *Sheet Metal Industries*, February, 1945, pages 317–327, 10 illus.

Spot Weld Characteristics of Aged 24S Aluminum. M. L. Ochieano. Methods of investigating the strength of spot welds of artificially aged 24S-T and 24S-RT clad aluminum alloys are described. Test data indicate that good weld structure, shear and tensile strengths, and satisfactory consistency in the strength of welds can be obtained. Conventional methods used in producing the welds are outlined. *Product Engineering*, February, 1945, pages 90–92, 5 illus.

Miscellaneous

Aviation's 1945 Yearbook. Aviation's twelfth annual directory contains a compilation of photographs, engineering three-view sketches, and descriptive data on American, British, Russian, Japanese, and German aircraft. Bombers, fighters, transports, liaison and training planes, personal aircraft, gliders, and helicopters are included. Separate specification tables are given for American engines, foreign engines, American and foreign gliders, American helicopters, American aircraft, Russian aircraft, and foreign aircraft (other than Russian). There is also a special expanded sketchbook of design detail, as well as a list of American fixed-base operators approved for flight training. *Aviation*, February, 1945, pages 119–201, 375 illus.

Technical Releases in 1944. A review of the technical developments that have taken place during 1944 in jet- and rocket-propelled aircraft, conventional aircraft (including fighters, heavy bombers, fighter bombers, military gliders, and marine airplanes), aircraft armament, aircraft engines, and aircraft accessories. British, American, German, and Japanese innovations are included. *The Aeroplane*, January 12, 1945, page 63.

After the War, What? Lt. Kenneth M. McClure. This is a report of a survey in which 280 Navy men were asked what they would like to do after the war. Those surveyed included 150 pilots, 50 aeronautical administrative officers and 50 mechanics aboard a combat aircraft carrier, and 30 miscellaneous Naval Air Transport Service pilots. *Air Transport*, February, 1945, pages 22–26, 5 illus.

Accomplishments of the Aircraft Industry in 1944. A statistical review of the achievements of the American aircraft industry in 1944. It is noted that, in 1944, 96,369 airplanes were produced and that this exceeded the 1943 production record by 10,500 aircraft. Production figures for the United States are compared with those of other countries, including Great Britain and the United Kingdom and Germany. Aircraft production trends are discussed. *Automotive and Aviation Industries*, February 15, 1945, pages 17, 56.

UNKNOWN TO MANY in the aircraft field, the versatile Kollsman Sensitive Altimeter has been playing an important part in precision bombing by our air forces, providing the vital altitude information for the correct setting of the bombsight. Accuracy in indicating pressure differences at high altitudes is one of the things that has made the Kollsman Sensitive Altimeter suitable for this job. With standard models already accurately indicating to 50,000 feet, and others under development with ranges up to 80,000 feet, the way is already well paved to accurate indication of altitude for whatever the future brings — to transport or military aviation — in the way of flight in the stratosphere.

KOLLSMAN AIRCRAFT INSTRUMENTS

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From the Industry

Improved Micrometer

A new and simplified design of the Micrometer Stop Countersink features the elimination of the conventional split keeper, the addition of an oversize phosphor-bronze radial bearing, and the installation of a simplified puller-nut to remove the cutter. Tests of the new design indicate a reduction of frictional heat as a result of the bronze bearing installation. The puller-nut permits removal of the cutter by a simple turn of the finger tips.

The manufacturer states that these improvements in design so reduce the countersink breakdown that repairs have become infrequent to a degree warranting a free reconditioning service at the factory, without charges other than the cost of parts used and the postage involved. Aero Tool Company, Burbank, Calif.

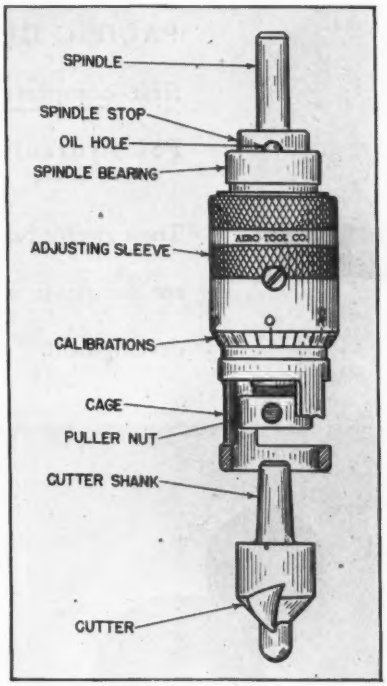
Two-Place, Two-Control Private Airplane

A new design for a postwar two-place, two-control, "spinproof," low-wing personal plane, with tricycle landing gear and all-metal fuselage, features large automobile-type doors, luxurious interior, enlarged baggage compartment, hydraulic brakes, and ball-bearing controls.

A starter and generator will be standard equipment of the new plane, which will be named the Chum. Large windows, including two in the top of the cabin, and a low cowling line, will give an extensive range of vision. The plane is now in the mock-up stage and the prototype is expected to undergo flight tests soon.

Complete specifications of the new design are as follows: wing span, 29 ft.; wing area, 140 sq.ft.; wing loading, 9.3 lbs. per sq.ft.; gross weight, 1,300 lbs.; power plant, 75 hp. engine; weight empty, 710 lbs.; useful load, 590 lbs.; fuel capacity, 23 gal.; cruising range, 470 miles; top speed, 120 m.p.h.; cruising speed, 108 m.p.h.; landing speed, 50 m.p.h.; rate of climb, 650 ft. per min.; baggage capacity, 70 lbs.

The new model is licensed by Engineering and Research Corporation under Weick U.S. Patent No. 2,110,516. Other postwar light-plane models scheduled for production after the war include the Chief and the Champion, both two-place private planes, and the Eagle, a four-place "family"-type craft. Aeronca Aircraft Corporation.



Aero Tool Company's Micrometer Stop Countersink.

Growth of Air Transport in 1944

New air routes available for the transportation of passengers and cargo in the United States, authorized by the Civil Aeronautics Board during the year 1944 to meet wartime needs, totalled 8,435 miles, or an increase in the 12-month period approximating the country's entire system of airways only 17 years ago. The total for the domestic air lines at the year-end reached the all-time high of 62,937 miles, to which 600 more miles were added in January of this year. Many schedules have been put into operation on the newly authorized routes to serve wartime needs, while others will appear on the timetables as rapidly as transport planes being returned by the Government to the air lines can be reconverted to commercial use.

The 1944 extensions involved 13 carriers and 24 routes, some relating to relatively minor terminal changes, but the majority introducing important new features in the domestic airway network. The longest item was 1,035 miles for Northwest Airlines from Minneapolis to New York.

This undertaking of extended service for wartime air travelers and shippers, as well as the delivery of mail, has proceeded without any slackening by the air lines in the pace of their war operations. Most of them are continuing direct war service for the Army and Navy on a contract basis, flying transports, remodeling planes, and training pilots and crews. The unprecedented increase in route mileage authorized by the Civil Aeronautics Board during the peak of the war is regarded by air-line executives as the most tangible evidence, not only of public confidence in the future of air travel, but in the ability of the air-transport industry to give safe and adequate service under trying conditions. In fact, the late Col. Edgar S. Gorrell, when President of the A.T.A., pointed out that the route-mileage increase in 1944 is the greatest in the history of air transport in the United States except for the year 1929, when the total extent of the airways was considerably less than half what it is today, and when most routes involved one or two trips per day, as contrasted with the present frequent departure times.

The 1944 figure represents an increase of about $15\frac{1}{2}$ per cent over the route mileage at the end of 1943. Air Transport Association.

The XP-77

Although stating that the plane is not scheduled at present to go into production for combat, the Air Technical Service Command has released some information about an all-wood fighter plane produced by Bell Aircraft Corporation for the Army Air Forces. The available data reveal that the lightweight, single-place fighter, called the XP-77, is 22 ft. $10\frac{1}{2}$ in. long. It has a wing span of $27\frac{1}{2}$ ft. and is powered by a single in-line Ranger V-770 engine. Provisions have been made for two synchronized 0.50-cal. machine guns and for a cannon to be fired through the propeller hub. Many of the details and specifications of the plane are still withheld. Bell Aircraft Corporation.

The Air-Position Indicator

The purpose of the Pioneer Air Position Indicator is to calculate by mechanical means the air position of a plane in terms of latitude and longitude. It computes from physical data, originally obtained from measurement of air speed and compass direction, an air plot, translated and indicated in terms of latitude and longitude. It is stated that the new instrument automatically

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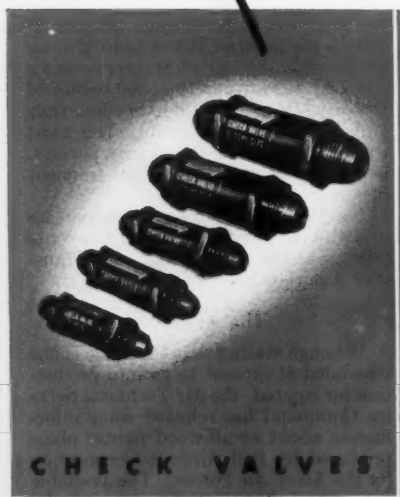
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In addition to the equipment illustrated, these 3000 PSI units shortly will be available: Sequence Valve, 10" Accumulator, 1/2" T.S. 4-Way Selector Valve and Relief Valve.

Write today for file folder containing complete data on these 3000 PSI units and which is available to airframe engineering personnel. Pacific Division, Bendix Aviation Corporation, 11620 Sherman Way, North Hollywood, California. Sales Engineering Offices in New York City and St. Louis.

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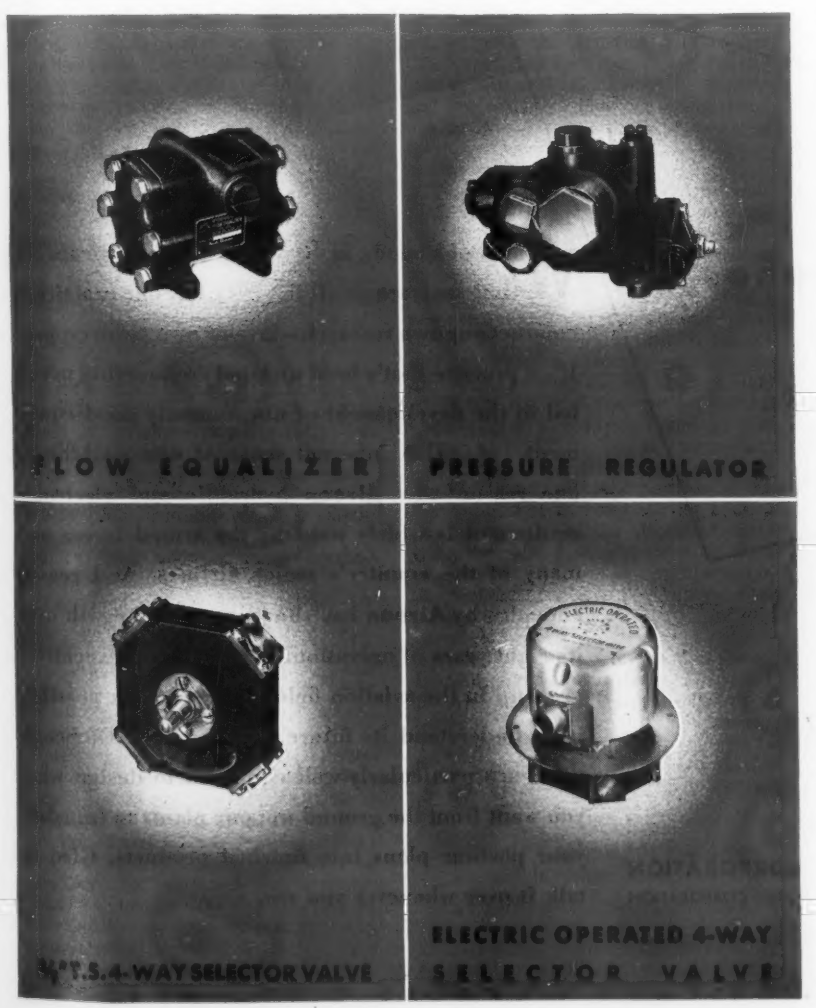

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WE'RE old hands at basic engineering. From the time we were small fry, it's been our practice to conduct our own research—lay our own cornerstones. It's a practice that's bred unusual engineering talent, led to the development of uncommonly good equipment. This inherent sense of responsibility is one reason why **Aireon** hydraulic and electronic equipment is widely used by the armed forces and many of the country's major airlines. And reason enough why **Aireon** has shown a steady growth over its eight years of operation. **Aireon** executives grew up in the aviation field; appreciate its possibilities, understand its future requirements. Our engineers are particularly well equipped to design what you want from the ground up; our plants to translate your postwar plans into finished products. Glad to talk it over whenever you say.

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computes a series of corrections, in addition to those made necessary by convergence of the meridians of longitude.

In achieving mechanical calculation of air position in aircraft, the instrument automatically resolves the direction and distance flown into latitude and longitude values of air position, in addition to correcting automatically for convergence of meridians. The computer contains a built-in system of friction drives, balls, and discs which integrate information supplied by the remote indicating compass and the distance element, consisting of an air-mileage unit and its controller. It is an aid to navigation, relieves fatigue, and eliminates guesswork in dead-reckoning navigation during flights through weather when celestial observations are not possible and radio reception is not available. When flying on a low-altitude bombing mission where pilotage navigation is not possible, the indicator takes over most of the navigator's responsibilities.

Basic problems on which the development of the indicator rested were involved first with finding a unit that would give a continuous indication of true air mileage and the correct true heading of the airplane, and to employ these factors to provide a continuous indication of latitude and longitude of air position. As part of the solution of these basic problems, it was necessary to provide a mechanical device to correct for the convergence of longitude meridians between the equator and the poles.

The first of these problems was solved by utilizing a control unit that would transfer the pressure relationship of the formula of true air speed into a mechanical function of revolutions of a shaft. The control unit operates a centrifugal-type pump, so designed that air under static conditions of pressure and temperature, received from vents in skin of the fuselage, is increased in pressure without changing the temperature, so that it is in constant ratio to the impact air pressure developed by the forward movement of the plane through the air. To keep this ratio, the pump will make a certain number of revolutions for each air mile traveled, in much the same manner as the wheels of a ground vehicle make so many revolutions for each ground mile covered.

The problem of providing a powerful electro-mechanical indication of true heading had already been solved by the Bendix-Pioneer development of the Gyro Flux Gate compass which feeds the correct true heading continuously into the computer system.

Integration of the pump shaft revolution with the true heading is accomplished by a combination of friction drives consisting of balls, driven between discs and rollers. A similar integration system is employed to provide correction for meridian convergence. There are nearly 500 closely finished parts and eleven separate gear trains in the computing device.

At the start of a flight, the latitude and longitude of the point of departure are set manually on the instrument. After this, at any time during flight, if the pilot desires to know his air position he has merely to read the two indicating counters. The air position can be converted to ground position by applying a wind vector line representing the direction and distance that the air has moved since the last position figures were set into the indicator. Bendix Aviation Corporation.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Transports Rebuilt for Return to Commercial Use

Rebuilding of the last of the five Boeing Stratoliners which recently were released to Transcontinental & Western Air, Inc., after 2½ years of transport service with the Army Air Transport Command, has been completed by the Boeing Aircraft Company in Seattle and the airplanes now are being fitted out by T.W.A. preparatory to resuming their former transcontinental commercial runs.

The rebuilding job has been so complete that, in effect, a new airplane has been created. The original wings have been replaced by the later model wings of the Boeing B-17G Flying Fortress. The planes have the 1,200-hp. Wright engines and the improved landing gear of the B-17G. New Hamilton Standard propellers also were installed. The new wings increase the load from 45,000 to 54,000 lbs. and the more powerful engines give a cruising speed of 200 m. p.h. at 10,000 ft. Range is more than 1,000 miles. New tail surfaces also have been installed, with the position of the horizontal tail surfaces moved back 3 ft. Dimensions of the airplane remain the same, with a wing span of 107 ft. 3 in., length of 74 ft. 4 in., and height of 21 ft. 1 in. Staterooms that were removed to increase the passenger and cargo capacity when the Army requisitioned the planes were not replaced. Instead, additional seats were installed, to bring the passenger capacity to 38 persons, five more than previously. The cabin pressure system will not be reinstalled until the required critical materials are available. Boeing Aircraft Company.

Electronic Controls for Processing Aluminum Sheets

Electronically controlled processes for the production of aluminum sheets for aircraft wings and fuselages are reported to have passed initial tests successfully. One of the first and largest electronic-instrument control installations is at the McCook, Illinois, plant of the Aluminum Company of America, where more than 400 recording and control instruments have been installed.

The electronic industrial-control instruments are being used at the plant for measuring temperature of aluminum ingots, slabs, and sheets. The instruments are installed at three different processing points, where temperature must be taken at extremely high speed for each of the three operations. Electronic instruments, unlike prewar mechanically operated measuring and control devices, were found to be unaffected by vibrational disturbances, even when installed in the immediate vicinity of traveling cranes that transported huge aluminum ingots from soaking pits. It was found unnecessary to provide special shockproof or vibration-absorbing equipment for the new electronic controls. Brown Instrument Company, Division of Minneapolis-Honeywell Regulator Company.

Buick Building Two More Aircraft-Engine Types

Two new types of aircraft engines are being built on the Buick assembly lines. One is a 14-cylinder Pratt & Whitney Twin Wasp, with 1,830 cu.in. displacement, which will give greater power, speed, range, and altitude to Liberator bombers. The other is a 14-cylinder Pratt & Whitney Twin Wasp with 2,000 cu.in. displacement for the Douglas C-54 military transport. Tooling for the new engines began last summer and necessitated a substantial retooling, engineering, and processing program. It was carried out by establishing new machining processes alongside the old, from which parts and subassemblies are fed to the main assembly line. Approximately 50 per cent of the man-hours required for the production of these engines are on machining operations in the Buick plants in Flint, Mich., with other machining, final assembly and testing taking place in the maker's Melrose Park, Ill., plant. Buick Motor Division of General Motors Corporation.

Engine Stand for Service Work

Model AC-1B aircraft-engine overhaul stand was designed particularly to meet the needs of fixed-base operators, charter services, aviation technical schools, and repair stations. With adapter brackets, various makes of radial and horizontally opposed engines up to 225 hp. can be accommodated. The tubular stand and other features enable the mechanic to move in close to his work. Engine balance is obtained by raising and lowering the mounting frame. Clayborne Manufacturing Company, Chicago.

Consolidated Vultee Model 37 Transport

It is reported that contracts have been awarded by Pan American World Airways for a fleet of 204-passenger land-based Clippers, capable of trans-

PRIZED MAINTENANCE AWARD

to Chicago and Southern

Captain John Maynard and Jane Russell, Hostess Supervisor, of Chicago and Southern, displaying the Maintenance Award.

"FOR outstanding maintenance performance and developments" Chicago and Southern Air Lines is winner of a trophy not lightly bestowed. It is the prized Maintenance Award of "Aviation." This award is service recognition of the men who keep Dixieliners flying the Valley Level Route between Chicago, New Orleans, and Houston.

In the establishment of maintenance records lubrication has a part. Chicago and Southern uses Sinclair Pennsylvania Motor Oils for safe, dependable lubrication of its planes. The Dixieliners have flown more than 18,585,000 revenue miles on Sinclair Pennsylvania exclusively.

SINCLAIR AVIATION OILS

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A model of the Consolidated Vultee passenger transport (Model 37).

porting 750,000 passengers per year in transoceanic service. The new Clipper will be 182 ft. long and will have a wing span of 230 ft. This wing span is more than twice that of the Liberator B-24 and is equal to the height of a 21-story building. It will be powered by six engines of a type now under development, mounted on the trailing edge of the wing and equipped with pusher-type propellers. Wing and empennage leading edges will be protected against formation of ice by a thermal anti-icing system. Cruising speeds at the normal range will vary between 310 and 342 m.p.h., according to altitude and power output. Cabins will be air-conditioned for operation at an altitude of 30,000 ft.

Carrying a pay load of 50,000 lbs. made up of 204 passengers and 15,300 lbs. of baggage, mail, and express, the new Clipper will have a range of 4,200 miles. Because airplanes of such size and speed require heavy traffic volume to realize maximum economies, the Pan American organization plans to utilize them only on long-distance, high-traffic-density routes where the severest foreign-flag competition will be met. Flight time from New York to London will be slightly more than 9 hours, and other schedules will be proportionately fast.

A full-scale model has been completed and more than 90 per cent of the initial engineering work is finished. The plane will be of double-deck construction. Nine staterooms accommodating two persons each, and twelve berths will be provided in one section. Luxurious passenger facilities, complete with two lounges and a number of rest rooms, have been designed to take full advantage of the large deck space. Accommodations will include separate quarters for the operating crew. Stewards, stewardesses, and galley attendants will be carried. Despite the size of the plane a single pilot will be able to handle it in the air. The weight and size of the new Clippers have been taken into account in designing several of the modern airports now being planned, such as Idlewild at New York. Consolidated Vultee Aircraft Corporation.

Time Chart

The Simplified Time Chart of the World is a chart divided vertically by the meridians of longitude at intervals of 5°, and horizontally by so-called "hour lines." These lines are so laid out that, for any point on the earth's surface, the corresponding time at any other point can be determined. The chart can also be used to determine the longitude of a ship or aircraft on the basis of a known celestial event, such as the setting of the sun, and the time. Diagonal lines across the chart divide the time indications into morning and afternoon zones. Instructions explain the use of the chart, the significance of the International date line, Army-Navy time, and other factors. Cornell Maritime Press, New York.

D.C. Time Relay

The Cramer Type MCR motor-operated d.c. time-delay relay was developed particularly for air-borne radio, radar, and electronic equipment. It can also be used in industrial applications where only d.c. power is available or in a.c. applications where, because of its small size, weight, or number of poles, it is better adaptable to the application than standard equipment.

These timers are available for standard time cycles, with maximum ranges from 25 sec. to 10 min., and minimum ranges from 1.25 sec. to 30 sec. Other special time ranges can be provided.

A frame made of Duraluminum with brass bearing inserts serves as a mounting structure for the complete timer mechanism. Four spacers insure accurate and parallel spacing of timer plates to avoid friction in bearings caused by torsional stresses. The bottom plate is arranged for three-point mounting.

The motor output shaft is connected to the cam-driving mechanism by means of a small universal joint and a cupped magnetically operated gear clutch through which the cam assembly shaft is driven or released. On the cam shaft a pair of cams rotate with the main shaft to actuate the switches. A return spring resets the cams to starting position when the timer is de-energized. The reset motion of the cam assembly is protected by a shock-absorbing stop arm.

Switch units are fully enclosed, single pole, double throw, with quick double-make, double-break contacts rated at 10 amp. on either 24 volts d.c. or 110 volts a.c., sea level to 40,000 ft. One switch unit is used to provide an independent load circuit. The second is used for the motor control and is set to cut out the motor circuit at the end of the shaft travel. A third switch for a second load circuit can be provided on special order. The R. W. Cramer Company, Inc., Centerbrook, Conn.

Vacuum-Grip Polishing Lathe

The Crozier Vacuum Grip polishing lathe handles parts and flat stampings made of copper, brass, aluminum, magnesium, zinc, plastic, or steel which cannot be held by chuck or collet. It generates its own vacuum, without piping or glands; starts, holds the work, stops instantly, and releases the work rapidly. All work is held firmly for polishing, burnishing, and many other operations.

The lathe has a threaded spindle. It is actuated by an 1,800 or 3,600 r.p.m., 220-, 440-, or 550-volt, three-phase, 50- or 60-cycle motor. The manufacturer designs and makes special fixtures for specific jobs. Crozier Machine Tool Company, Hawthorne, Calif.

Hydraulic Adjustable Seat

Featuring the recently perfected Hydrolok seat-locking mechanism, a new lightweight seat designed by Douglas engineers reduces the weight per 21-passenger plane by 147 lbs. and costs but slightly more than half the price of the old-type passenger chair. The Hydrolok feature, which permits instant and positive finger-tip control of the seat back, was developed from a plant suggestion submitted by an employee.

The design incorporates a quick-removable feature that permits the seats to be taken out in a very few minutes to adapt the plane for cargo use, the floor fittings becoming light-cargo tie-downs. Dimensionally, the chair is identical to the standard DC-3 passenger chair. The cushions now used are complete assemblies and employ a snap-on feature for quick installation or removal. Douglas Aircraft Company, Inc.

Self-Locking Pins

Standard and special self-anchoring, vibration-proof pins are designed to replace more expensive taper pins, keys, cotter pins, set screws, rivets, etc. These pins, which are pressed or driven into standard drilled holes, have four flutes on the surface parallel to the axis. The length and position of the flute can be controlled accurately, so that fully or partially grooved pins are available. Fully grooved pins have a pilot at one end so that the pin can be easily inserted.

The raised, work-hardened edges of these flutes provide an expanded diameter of a specified number of thousandths greater than the nominal diameter of the pin. When the pin is inserted in a drilled hole, these raised edges are compressed inwardly, providing a resilient, self-locking element which, it is claimed, will hold indefinitely under vibration or shock conditions. They are available in sizes from $^{3}/_{64}$-in. to $^{1}/_{2}$-in. diameter, and from $^{3}/_{16}$-in. to $4^{1}/_{2}$-in.

TEL-AIR PARTS COUNT—*in the* ACHIEVEMENT *of* VICTORY—

Another Tel-Air Part
Small segment showing three operations — blanking, cutting the teeth, and forming. Note comparative size.

Even such tiny segment gears as the one illustrated here must be unfailingly accurate in operation if some essential war machine is not to falter in its mission of destroying the enemy.

Tel-air accuracy means absolutely uniform precision, tolerance and concentricity in every machining and finishing operation. It is this kind of precision engineering and workmanship that we are putting into intricate bomb fuses and hundreds of vital component parts for the war effort.

Now! We are Not Interested in our Post-War Products

We Are Only Interested in Winning the War.

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length, in any material, and in a wide variety of types. Driv-Lok Pin Company, Chicago.

Radio Direction Finder for Aircraft

Described by the manufacturer as the first radio direction finder in which no a.c. supply from the aircraft is needed, a new Fairchild compass is a four-band instrument that is 28 per cent smaller in size and 21 per cent lighter than the old three-band model.

Only the regular aircraft storage battery supply of 28 volts d.c. is required for the new model, rather than 100- to 250-volt plate currents that are standard in other equipment. Alternating-current voltages for the indicators and the loop-drive motor are formed by means of a small vibrator and the 28-volt d.c. supply, and reception continues if the a.c. voltages fail; then the loop can be turned manually and there is aural indication of the course.

There are both strategic and scientific reasons for the addition of a fourth band in the compass. Fairchild's former model, the SCR-269, provided the 200-410, 410–850, and 850–1750 kilocycle bands. The new development also has the 100–200 kilocycle band frequency. The strategic reason is to take radio navigational aid from the many European and Asiatic stations that broadcast in the 100–200 kilocycle field. The scientific reason is that at night there is less scattering and shifting in the path of these frequencies between a radio station and a remotely located aircraft, thus providing superior night navigational properties.

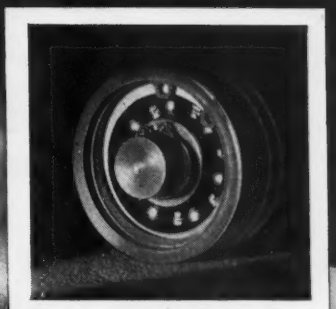
The new smaller and lighter equipment makes automatic radio-compass navigation available for smaller aircraft, such as long-range fighters. The Fairchild instrument was developed in cooperation with the War Department and was tested at Wright Field under supervision of the Aircraft Radio Laboratory, Communications and Navigation Section. Many structural improvements are reported to be incorporated in the new compass. Fairchild Camera and Instrument Corporation, New York.

Litter Suspension for Ambulance Planes

To replace the old type of litter suspension used for ambulance work in converted passenger planes, Fairchild engineers developed for the C-82 Packet a comparatively simple arrangement of web straps that eliminated the numerous disadvantages of the old method. After tests at the Aero Medical Laboratory at Wright Field, special features were added and later it became standard equipment on all large military aircraft operating as ambulance planes. In addition to the C-82 Packet, the C-46 Commando, the C-47 Skytrain, and the C-54 Skymaster are now using this equipment.

There is provision for 34 litter strap supports in the Packet. Each tier of litters is suspended from the ceiling and hooked to cargo tie-down fittings

MORE USEFUL THAN EVER . . .



Bearing shows two uses of Waldes TRUARC Retaining Rings. External *ring fits into grooved shaft and holds bearings in place.* Internal *ring fits into grooved housing and holds bearing in the housing.*

. . . now that they are made in

CORROSION-RESISTING "K" MONEL

WEIGHT-SAVING, TIME-SAVING advantages have already won wide use for Waldes TRUARC* Retaining Rings.

But now that they're available in "K" Monel, their usefulness is extended to applications where special mechanical needs—*or corrosive influences*—formerly forbade their use.

Because they can be heat treated, Waldes TRUARC Retaining Rings made of "K" Monel possess strength and hardness comparable to that of heat-treated alloy steel.

Their resistance to shear-rupture is even *greater* than that of steel. Their resistance to impact is not impaired by sub-zero temperatures.

They are *permanently* safe from corrosion.

Moreover, the non-magnetic quality of "K" Monel opens possibilities for their use in (or around) those instruments where magnetic disturbance cannot be tolerated.

"K" MONEL is especially useful for this application because it provides the combination of properties that is so often needed. Like other manufacturers seeking a metal to fit "special" conditions, the makers of these rings looked for their solution among the INCO Nickel Alloys *and found it.* For more information on these eight problem-saving metals, send for your copy of *"Selected Metals for Aircraft Uses."*

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET, NEW YORK 5, N.Y.

*U.S. Pat. Reg. 18,144

What are Waldes TRUARC Rings?

In many industries, especially the aircraft, TRUARC Retaining Rings are used to lock, secure or position moving parts, be they shafts, gears, bushings or bearings.

They are available as *internal* rings for fittings into grooved housings or as *external* rings for fitting around grooved shafts or pins.

Their use safely saves weight, space and machining costs, while simplifying assembly and disassembly.

Two outstanding features make these rings superior to ordinary spring retainers:

1. The eccentricity of their outer and inner diameters ensures a perfectly circular fit at all times.
2. Apertures in their free ends permit quick insertion or removal by expanding or contracting with pliers. *(See large photo above.)*

A leading aircraft manufacturer uses TRUARC Retaining Rings wherever possible:

. . . as retainers in place of shoulders, nuts and threaded collars

. . . to position bearings, bushings, shafts and pins

. . . to take high axial loads in place of shoulders

. . . to save weight, assembly time and machining costs.

TRUARC Retaining Rings are made by Waldes Kohl-Noor, Inc., Long Island City, New York.

"K" MONEL

NICKEL INCO ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL
Sheet . . . Strip . . . Rod . . . Tubing . . . Castings . . . Wire . . . Welding Rods (Gas and Electric)

NOW! 9000 Heat Exchangers Installed Without One Reported Failure!
STILL MORE PROOF that South Wind is first in heating! Now, 9000 South Wind exhaust gas heat exchangers are in action—many of them in continual action for approximately a year.
Out of 9000 South Wind heat exchangers in use, there has been not one report of failure or leakage except through damage by flak. As far as we know, this is a record absolutely unparalleled for high output heat exchangers!
Some of the reasons for the success of South Wind heat exchangers are:
Our method of construction permits internal flexibility which minimizes thermal stresses, which are the cause of most heat exchanger failures.
The use of round tubes permits the lightest form of construction capable of withstanding pressure without distortion. Some of our exchangers provide as much as 15,000 BTU per pound of weight, exclusive of adapters. They are capable of withstanding the greatest pressures to which they can be subjected, such as backfires, etc.
Because of our experience in designing and testing a great variety of heat exchangers, we can produce designs to meet the most exacting specifications with complete assurance that the results will be satisfactory.
At Stewart-Warner, the search for even better heating never ends. It is this continuing research and refinement that has placed South Wind first in experience, first in production and first in performance.
If you have a heat problem, South Wind engineers have several courses of action from which to choose. Your needs may call for exhaust gas heat exchangers or for one of the numerous flight-proved South Wind hermetic combustion heater models. Either way, you are assured of the finest heating engineering available today—and tomorrow!
South Wind Heating
Heater Division, Stewart-Warner Corporation, Chicago 14, Ill.
West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service
1273 Westwood Boulevard, West Los Angeles, Calif.
STEWART WARNER

in the floor. At regular intervals within the length of the web straps that hang from the ceiling are loops into which the litter handles fasten, and a clamp attachment to tighten the loop around each handle. All of the litters extend out from the walls in the cargo compartment and are held in place against the walls by wall brackets that are the same distance from the floor as the corresponding loops in the straps. Ample space is provided between litters for loading activities.

The entire installation is a part of the permanent equipment of the airplane, and when not in use the straps can be unhooked from the floor and rolled up into stowage bags located on the ceiling near the upper support.

The strap litter-suspension method is economical of weight and space. It averages only three pounds per litter which is less than half the weight of the metal types and the straps take up far less space, both when in use and when stored. When not in use litters are stored under the plywood floor. Another advantage is in the loading procedure. Each tier is filled from the top down. Thus, when litters on the upper levels are placed in the tiers, only the loose straps extend down instead of the metal structure which formerly slowed the job of getting wounded men into the transport. Practically all metal has been eliminated and, along with it, the danger of a soldier hurting himself by striking a hard surface. Since the strap supports are flexible, they provide some measure of shock absorption. Fairchild Engine and Airplane Corporation.

Feeder-Line Air-Travel Survey

Results of a survey of the postwar demand for feeder-line air service show that, contingent upon the development of a suitable plane, a potential market for 500 to 600 new short-haul aircraft in the United States may exist within the 3-year period after sales are approved. The survey estimates were derived from an analysis of feeder-line route applications, Civil Aeronautics Board policies, economic factors affecting local air transportation, and the effect of war-surplus aircraft on initial requirements.

If feeder routes are granted by the Civil Aeronautics Board in the near future, surplus military aircraft may have to be used for a short time. Rapid replacement of the surplus aircraft should occur when planes become available which are capable of providing the marked operating economies required for the low-cost, short-haul travel market.

Projected feeder-line applications average 358 miles per route, with 54 miles between stops and 19 miles between mail and express pickups. The average figure shows 5.5 stops and 17.8 pickups per route. About every 140 miles each route would have a junction point with other air-line routes. Short hauls, according to the survey, would demand high frequency of service and fares less than half of present air-line rates. Many economies of operation can be effected

A simple arrangement of web straps in the Fairchild C-82 Packet replaces the old type of litter suspension used for ambulance work. The above photograph shows this method undergoing test in a C-82 mock-up.

by the operators but substantial savings must be obtained through increasingly efficient aircraft and power-plant design.

Indications are that one of the most suitable types of aircraft for short-haul work would have a flexible capacity for 8 to 12 passengers and 200 to 1,000 lbs. of cargo. A desirable cruising speed of 165 m.p.h. is indicated and the airplane should be sufficiently flexible to provide passenger service, mail-express pickup service, or both. Its small size would enable operators to provide high frequencies of service with lower capital investment. It appears that a range of approximately 230 miles with full pay load, 315 miles with 70 per cent optimum pay load, and an absolute range of approximately 470 miles with 35 per cent pay load, including standard fuel reserves, would be satisfactory. The survey also indicates that initial and operating costs would be more important than high performance.

It is estimated that such a plane might cost from $50,000 to $70,000, and should operate on a direct flying cost of 17 cents to 20 cents per airplane-mile. If indirect expenses are double this direct flying expense, operators could achieve the desired minimum passenger fare of 3.5 cents per passenger mile, assuming express revenue would not exceed that now realized and that there would be a compensatory mail rate. Fairchild Engine and Airplane Corporation.

The General Controls Company's Model AV-16 shut-off valve.

Electric Motor Valve

A new electric-motor-operated shutoff valve for fuel, hydraulic, and lubricating oil systems is designated as the AV-16 series. This valve is credited with several desirable features. It is said to be "clean" in appearance, light in weight and compact, and to provide high flows at low-pressure drops and low current consumption when energized. It has an explosion-proof motor and switch cover, standard Army-Navy or terminal-type electrical connections, and tube or flange fluid connections in sizes of $^3/_4$ in. to 3 in. General Controls Company, Glendale, Calif.

Nonthermoplastic Adhesive

Plastilock 500 is a nonthermoplastic, water- and aromatic oil-resistant adhesive for bonding metals, wood, plastics and ceramic material to themselves or to each other. The manufacturer states that in some cases it can be used in place of rivets or screws.

The new adhesive, used for metal-to-metal bonding, has shown a shear strength of 3,250 lbs. per sq.in. Tension strengths of 4,000 lbs. per sq.in. have been reached. Tests made after the bonding of wood and plastic to aluminum have resulted in the wood and plastic being torn because the strength of the bond was greater than that of these materials.

In using Plastilock 500, the maker advises that best results are gained by applying heat with pressure, although heating alone will give some degree of adhesion. The purpose of the pressure is to obtain good surface contact. The bond strength varies with the materials being adhered. The B. F. Goodrich Company.

High-Pressure Portable Degreasing and Cleaning Unit

Improved efficiency and economy of degreasing and cleaning in aircraft maintenance are claimed for the newly developed Hydra Lectric Hy-Pressure cleaning and degreasing unit, because it provides a hot-water-borne grease-emulsifying solution at high pressure in ample volume to clean and flush the job in a single operation. Portability makes the unit useful on a wide variety of jobs, such as cleaning of aircraft exteriors prior to waxing, line-maintenance cleaning of engines, cleaning engines prior to

This advertisement is one of a series which is appearing in national magazines and newspapers as Consolidated Vultee's contribution toward a clearer public understanding of transportation's role in the war, and its postwar opportunities and responsibilities.

How'd you like to own a "Flying Jeep"

1. **The Army nicknamed** this amazing plane the "Flying Jeep." It can take off and land almost "on a dime." They use it for many jobs: as the "eyes upstairs" for artillery units . . . for laying Signal Corps wire over jungle and impassable terrain . . . and for photo and reconnaissance work. It has even hovered over battling tanks in Burma, observing and directing the conflict from the air.

2. **When the Army wanted** a flying ambulance to evacuate casualties from small jungle clearings and inaccessible battle zones, the versatile "Flying Jeep" took on *this* job, too. Many a wounded American boy is alive and well today because this tiny Consolidated Vultee plane speeded him to the base hospital in *minutes*, instead of the hours it would have taken stretcher bearers to make the arduous trip.

LIBERATOR . . . *4-engine bomber*

The giant Consolidated Vultee Liberator bomber, with over 3000 miles flying range, tremendous firepower, speed, and multi-ton bomb load, has been blasting the Axis with devastating effect from Berlin to the South Pacific.

LIBERATOR EXPRESS . . . *transport*

This cargo-passenger version of the famed Liberator bomber can carry many tons of military equipment for thousands of miles, nonstop. It is daily shuttling personnel and supplies across both the Atlantic and the Pacific.

SENTINEL . . . *"Flying Jeep"*

The Consolidated Vultee "Flying Jeep" is a glowing example of how a peacetime plane went to war. Modified to perform combat tasks, it has proven to be one of the AAF's most versatile light planes.

CATALINA . . . *patrol bomber*

The twin-engine "Cat" is the Navy's most famous patrol bomber. It has turned in a glorious performance record, not only as "Eyes of the Fleet," but as a torpedo plane, long-range bomber, rescue plane, and transport.

CONSOLIDATED VULTEE AIRCRAFT

after the war?

3. **Your postwar "Flying Jeep"** may not look exactly like this. But you can be certain it will be safe, easy to fly, and an economical family plane. Well suited, too, for vacations, inter-city travel, for aero clubs and "Fly-it-Yourself" stations . . . for farmers, sowing and dusting crops . . . for forest patrol and fire spotting . . . for policing and traffic control . . . and for survey work . . . an ideal all-purpose small plane.

4. **The Japs and Germans** didn't think that America, so unprepared, could produce *so much, so fast.* If they ever start another war, they will not forget their fatal error.

But they will not be apt to start another war if we keep America strong, invincible. The mere fact that we *possess* and *maintain* a powerful Army, Navy, and Air Force will discourage such unprovoked attacks as we suffered at Pearl Harbor.

American Air Power is one of our best guarantees of a lasting peace in a world where vengeful sparks of aggression may still be smouldering a generation hence.

No spot on earth is more than 60 hours' flying time from your local airport

Don't miss it! The screen version of Moss Hart's great stage hit — presented by 20th Century-Fox, in association with the United States Army Air Forces.

"Winged Victory" is the name given by the heroes in the film to the Consolidated Vultee Liberator Bomber used in the picture.

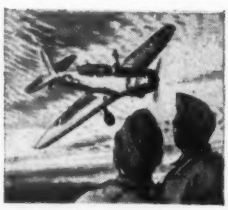
MOSS HART'S

Winged Victory

PRODUCED BY DARRYL F. ZANUCK . . . DIRECTED BY GEORGE CUKOR.

RELIANT . . . *navigational trainer*

A favorite plane of many private flyers in peacetime, the wartime version of the Reliant is now used by Royal Navy pilots, for instrument-flight instruction and navigational training.



VALIANT . . . *basic trainer*

The Valiant is a swift, rugged two-place basic trainer, in which practically all of the Army and Navy pilots in this war received their basic training. This dependable trainer has a service ceiling of 21,000 feet.

(All the planes shown here were designed and developed by Consolidated Vultee)

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STAINLESS guards these "hot spots" in the B-29

A Fwd. Collector Shroud
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D Exhaust Collector
E Flight Hood
F Longeron
G Waste Gate Exhaust Pipe
H Inner Cowl
I Nacelle Shroud
J Slide Panel

Like all American warplanes, Boeing's super-battleship of the air is well equipped with stainless steel parts. This rustless metal is used wherever great strength and prolonged heat resistance are vital to efficiency and safety.

Some parts made of ARMCO Stainless Steels are indicated in this close-up view of the B-29. The four great housings of the Superfortresses' 2200-hp. engines embody stainless steel, selected for its strength and resistance to intense heat generated by the mighty power plants.

Other parts, like the collector systems, must "take it" too. In endless hours of combat flying, red-hot corrosive gases blast their way through exhaust collectors. And vibration puts stainless to a severe test. Yet this heat-resisting metal comes through unscathed in flight after flight.

You'll approve these other advantages of ARMCO Stainless Steels too: They form easily and can be fabricated by the fast spot-welding process. The strength-weight ratio is exceptionally high.

If you want qualities like these in your future products, consider using ARMCO Stainless. There is a grade for every requirement. For complete information just address The American Rolling Mill Company, 3561 Curtis Street, Middletown, Ohio.

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MADE OF ARMCO STAINLESS STEEL

tear-down, precleaning of parts after engine tear-down, cleaning of floors, test cells, automotive equipment, and general plant maintenance.

The unit delivers a grease-emulsifying solution (either hot or cold) in volume of 5 gal. per min. at 300 lbs. pressure at the nozzle. For heavily dirt-encrusted and carbonized surfaces the unit is designed to apply a presoak solvent oil that quickly loosens the hard-packed layer of grease and dirt preparatory to high-pressure cleaning.

The machine consists of two tanks, a 24-gal. tank containing the cleaning chemical in concentrated solution, with automatic agitator and strength control, and a 34-gal. presoak solution tank. These tanks feed through a by-pass valve to a motor-driven impeller pump that requires no bearings, packing, gaskets, or pump lubrication. A valve for metering the compound concentrate at uniform strength into the water is provided between the concentrate tank and the mixing tank. A steam coil is provided to heat the solution if steam is available; or, if hot water is available, it may be directly connected to the unit. The unit is also manufactured as a compact, portable, self-contained oil-fired machine that will operate in the field or wherever hot water or steam are unavailable. Hydra Lectric Products Corporation, Indianapolis.

Compact Dust Collector

A powerful yet inexpensive unit-type dust collector has standard attachments to simplify installation on grinders, buffers, sanders, polishers, lathes, and other machines. A flow of 500 cu.ft. per min. is developed through the two inlets by a $^3/_4$-hp., 3,450-r.p.m. motor, driving a $7^1/_2$-in. diameter by 2-in. wide squirrel-cage blower wheel.

Dust-laden air is drawn through the inlet pipes into twin cyclone separators where it is whirled around at high speeds. The dust particles move more slowly and drop down into the dust drawer. The air passes on through a viscous-coated filter where extremely fine dust is removed. Clean air is discharged back into the room. The two 3-in. diameter inlets can serve either one or two machines.

The filter consists of 20 layers of viscous-coated filter paper. To restore the filter's efficiency after it becomes dirty, it is necessary only to peel off the first two layers. This can be done five times without affecting its cleaning ability. Under average conditions a filter lasts approximately a year.

Dimensions of the unit are 20 in. by 20 in. by 38 in. high. Shipping weight is 265 lbs. Ideal Commutator Dresser Company, Sycamore, Ill.

Two Diamond Grinding Wheels in One

The Dual Purpose Super-Cut Zurium Bonded diamond wheel is offered as two diamond wheels in one, for rough grinding and fine finishing of cutting tools. The maker states that the wheels are manufactured under an exclusive process that securely locks diamonds in the matrix, layer upon layer.

Of the two separate grinding surfaces, the outer (7°) beveled surface contains layers of coarse diamonds whereas the inner flat surface is built up of fine diamonds (400 mesh). By merely angling the side or point of a carbide tool, it is reported that the tool can be rough ground and superfine finished in 6 sec., without the operator having to shift his position. Time and steps are saved because no wheel change-over is required. Industrial Abrasives, Inc., Chicago.

Retracting Electrical Cord

Kellogg Koiled Kord is a spirally molded, rubber-covered electrical cord of one or more copper conductors, designed to provide a simple and practical means to stretch a cord to the desired distance and have it retract itself to its original spiraled length. Because it is permanently molded by a vulcanizing process into the spiral shape, its expanding and contracting action is secured without the aid of springs, rubber bands, or other mechanical means.

It is stated that the Bureau of Aeronautics, Navy Department, has specified its use in Navy plane cockpits. It may be used for both radio and interplane telephone communications. Kellogg Switchboard and Supply Company, Chicago.

The P-80 Shooting Star

General H. H. Arnold, Commanding General of the U.S. Army Air Forces, has announced the production of a new jet-propelled fighter, which has been in secret development for more than a year. This airplane, designated by the Army as the P-80 Shooting Star, is stated to be faster than any planes the Germans or Japanese have flown, including the Me 163 rocket interceptor, and is also highly maneuverable. The design was developed by Lockheed Aircraft Corporation, with the aid of the Air Technical Service Command at Wright Field, and the cooperation of the Royal Air Force.

The P-80 operates over any of the ranges the conventional pursuit planes of today are called upon to perform, indicating the solution of one of the major problems of design in jet-propelled airplanes. It is powered by a General Electric G-E turbojet engine, patterned upon basic principles developed by British Air Commodore Frank Whittle. The power unit is called the G-E Jet. It is installed in the tail of the P-80 and develops more than twice the power of the earlier model of jet engines first produced by General Electric for the A.A.F. This engine is also far more powerful than any present conventional reciprocating engine for aircraft. The engine is reported to operate with virtually no vibration. It is simple to maintain, having few movable parts. Pilots of a P-80 hear no noise from the jet while in flight.

Advanced types of these units are in production for the A.A.F. at the General Electric Company's works at Syracuse, N.Y., and will also be manufactured by the Allison Division of General Motors Corporation.

The wing of the Shooting Star, so refined as to class it as a new type of wing, has a knife-like leading edge and other aerodynamic innovations that contribute to the solution of the problems encountered when the speed of sound is approached or surpassed. Streamlined air-intake ducts are located on each side of the fuselage just forward of the leading edge of the wing. Air flows through these ducts to the compressor of the power unit and into a chamber where it is heated and expanded by a burning fuel similar to ordinary kerosene.

Rate of climb and angle of climb of the Shooting Star at high speeds are reported to be exceptional. The bubble canopy, location of the cockpit forward of the wing, and the slender lines of the nose give the pilot a wide range of vision for all combat maneuvers. The engineers have given great consideration to pilot comfort. The pressurized cabin is equipped for pilot "G" suits to ease the discomfort of sharp turns and pull-outs. Small and light in comparison with reciprocating-engine pursuit planes, the Shooting Star is made maneuverable through the use of a hydraulic aileron boost and electrically operated flaps. It can carry heavy loads of ammunition, photographic equipment, bombs, and fuel. The ceiling of the Shooting Star is stated to be above that of propeller-driven planes. The figure representing thrust power of the engine is restricted. Wing loading is less than that of an average fighter plane.

The simplicity of design and construction of the P-80 and its ease of maintenance are typified by the fact that the engine can be replaced completely within 15 min., compared with the 8 or 9 hours required for engine change on a standard fighter. The armament is concentrated in the nose.

Four Lockheed plants will concentrate on production of the Shooting Star and, in addition, the Kansas City plant of North American Aviation, Inc., will engage in its production. Lockheed Aircraft Corporation.

Improved Cowl Fastener

A lightweight, self-aligning, spring-lock fastener of unique design, which is reported to offer many advantages over other fasteners, will soon be made generally available. Called the Carlso fastener, it was originally designed to overcome difficulties in attaching aircraft cowlings but has since demonstrated its adaptability as an all-purpose fastener for aircraft and other applications.

The Carlso fastener consists of two parts—a stud and a receptacle. The stud has a squared shank on which two opposed sides are serrated; the receptacle is of spring-clip design and engages the serrations in the manner of a ratchet to secure the stud in place. Since the serrations run the full length of the stud and the receptacle is flexible, it is possible to use one length of stud for all applications, as compared with 30 to 40 lengths required with other fasteners.

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For more than 30 years Roebling engineers and aviation engineers have worked closely together, contributing specialized skills but talking the same language . . .

About aircraft's special needs today and tomorrow . . . the new and more efficient devices that are possible and practical with Roebling wire and wire products . . . ways and means of constantly improving control system research, design, maintenance.

Add this *extra* know-how to a century's experience in fine wire-making . . . and to the facilities, products and services we offer to aircraft manufacturers. It all makes Roebling today an ideal single source of supply for your requirements—in Control Cord and Strand . . . Terminals . . . Complete Swaged Assemblies . . . Control Casing . . . Special Wires and Cables . . . Slings.

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This permits starting the studs with the two pieces out of alignment and letting them align themselves as the studs are driven home.

To fasten a cowling with the new fastener, it is first brought into approximate visual alignment. Since there is no cross pin, the studs can be removed to permit visual installation, although a horseshoe washer may be used to keep the stud in the dimpled hole when desired. Then the studs are started one at a time. After all studs have been started in their respective positions, they are driven home with a screw driver, a single sharp tap sufficing for each stud. In this way it is possible to draw the cowling evenly and surely into place.

To remove a cowling fastened with the new Martin device, it is necessary only to turn the studs a quarter-turn in either direction to disengage them. Although the studs are easily disengaged when desired, it is stated to be impossible for them to loosen because of vibration.

The Carlso fastener in a number 7 size is interchangeable with AN-228 and AN-232 fasteners as far as the drilling and dimpling of the sheets on which it is mounted is concerned. With a single receptacle it can withstand loads in excess of 900 lbs., and this can be further increased by stacking—that is, by nesting two or three receptacles to engage a single stud. The Glenn L. Martin Company.

Centerless Grinding of Bushings

Bushings are now being ground on centerless grinders by means of a new attachment that makes it possible to hold tolerances within the necessary close limits. The new device comprises an adjustable block carrying an arbor that assures that the external circumference of the bushing and the internal holes are concentric. It is attached to the side of the grinder by means of a bracket which supports the block through an adjustable dovetail joint.

In use, the hole in the bushing is finished to size in the conventional manner and it is then placed on the arbor with a sliding fit. The block is then rotated by means of a handle until the bushing engages the wheels of the grinder for about $^1/_{32}$ in. The feed wheel then draws the bushing off the arbor to the grinding position between the wheels. The external periphery of the bushing has to be ground true, because the arbor is approximately $1^1/_2$ times the length of the bushing and the bushing is ground for its entire length before leaving the arbor. The only possibility for error in concentricity in this arrangement is in the tolerance of the sliding fit between the bushing and the arbor.

The new device has made it possible to use centerless grinders for bushing-grinding jobs that previously required the placing of each bushing on an arbor and the centering of the arbor for each individual job. The Glenn L. Martin Company.

"Nibbler" for Cutting Engine-Mount Tubing

The need for a method of speeding up the milling of engine-mount tubing has resulted in the tubes now being "nibbled" to desired lengths rather than burned off or cut by various other methods.

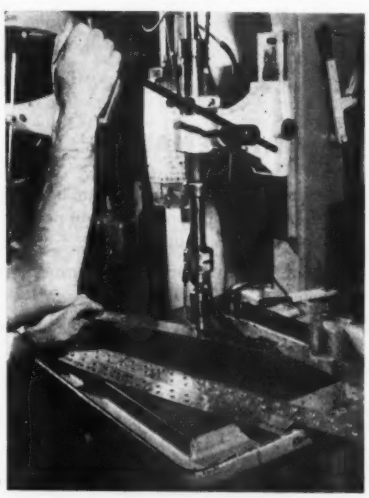
The most important problem was cutting the tubing along "special" patterns, since milling machines were not quickly adaptable to this work. A check revealed that it required an average of 24 min. per tube to complete this operation. It was found that some companies were burning off the tubes, but this method required the installation of special, expensive machinery and resulted in little saving of time.

No machine was available in the plant to implement an experiment in "nibbling" the tubing, so a special die that could be used on a punch press was cut, giving the same result that would have been attained from a nibbling machine. This worked well and shortened the process, but it was believed that still more speed and efficiency could be obtained with a machine especially designed to do the job.

Shortly afterward the first "nibbler" was installed. Now cutters trim the tubes to the correct lengths and the cutting time has been reduced from 24 to $1^1/_2$ min. As a result of the new operation very little scrap results in the cutting process and there is no longer any need to worry about how hard the ends of the tubes become during the original cutting process, as hardness has no effect on the "nibbler." Operating the machine is a relatively simple process, requiring only the ability to follow a simple pattern. The Glenn L. Martin Company.

Dimpler for Hard Metals

A new tool for dimpling hard and brittle sheet metals such as Reynolds 301-T, Alcoa 75-ST, and the new lightweight magnesium alloys, thus extending their range of usefulness to the aircraft industry, will soon be made generally available through licensed tool manufacturers. Known as the Martin Spin Dimpler, the new tool is used in a standard drill press and forms the dimple by spinning the metal rather than by pressing it into shape. In experimental use, perfect dimples have been formed in both 75-ST and R-301-T in from 2 to 5 sec. per dimple and in cold AMC-52-SH in from 5 to 9 sec. per dimple. The same tool was used for both aluminum and magnesium alloys, but a lubricant was used with the former and omitted with the latter.



Forming a dimple in 75 ST sheet aluminum with the new Martin spin dimpler.

The actual spin dimpler consists mainly of four parts. These are a female die, similar to that used with a pressure-pad dimpler, into which the metal is spun; a male spinning tool; a trimmer cutting edge to remove any metal that is extruded upward during the forming of the dimple; and a pressure-pad assembly for holding the sheet in place during dimpling. The spinning tool itself has several projections that are rounded off to eliminate machining of the metal from the inside of the dimple. To permit easy replacement, it screws into the pressure-pad assembly shaft.

In operation the spin dimpler has been used on a single-spindle Allen drill press but is equally adaptable to any drill press capable of supplying 1,500 r.p.m. rotation, and presents no undue problems for the unskilled or semiskilled worker. Exact centering of the dimple is assured by a tip on the spinning tool exactly fitting the inside diameter of the rivet hole.

Dimples formed by the spin dimpler feature a sharp edge similar to a machine countersink, leaving no void around the rivet head as in the case of the ordinary pressed dimple. Despite the fact that the cladding of the sheet is partially removed by the trimming edge, comprehensive laboratory tests have demonstrated that the spun dimple resists corrosion as well as a machine countersunk hole.

The spin dimpler has been used to form 100° dimples for $^3/_{32}$-, $^1/_8$-, $^5/_{32}$-, and $^3/_{16}$-in. diameter rivets in both aluminum and magnesium alloys varying from 0.020 to 0.064 in. in thickness. In the case of aluminum, Tycol-655 was used as a lubricant. The Glenn L. Martin Company.

Improved Method of Installing Bearings

To facilitate replacement in service and improve production methods, bearings will be staked, instead of spun, into aircraft parts on future models, except for assemblies in magnesium-alloy housings. The staking is performed by placing the part containing the bearing between upper and lower dies in a punch press. The dies are constructed with projecting staking bits that force the housing material over the edge of the bearing in six places around its perimeter, thereby anchoring the bearing firmly within its housing. Both sides of the housing are staked simultaneously by a single stroke of the press. In the swaging method formerly used, it was

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W. C. MENTZER, *Chief Engineer, United Air Lines*

"With larger, faster planes in the 'Age of Flight', the airlines should be able to carry 80 per cent of all long distance first class passenger traffic," says W. C. Mentzer. "But they will have to reduce fares substantially in order to penetrate new, broader markets. That means that we must strive for longer plane life and lower maintenance costs. We, at United, are proud of our high maintenance standards. We aim to keep them high. But we are also engaged in continuous study of ways and means of reducing maintenance costs. Our post-war DC-4's and DC-6's will come equipped for long, safe service."

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BOOTS STEEL ANCHOR NUT

(W2S #8-32)—The comparable fibre-type nut is more than 2½ times as heavy as this Boots all-metal nut.

Send for Free Weight-Saving Booklet

Actual weights of over 250 different self-locking nuts used in aircraft, comprehensively reviewed for the convenience of aircraft designers, engineers, operating and maintenance personnel. Copy will be sent you, free, on request.

BOOTS SELF-LOCKING NUTS

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necessary to hold the part in a block on a drill press and spin the metal over the bearing around its perimeter.

The advantages of the new method are ease of service repair and saving of material. With the spinning method there was no assurance that a damaged or worn bearing, after removal from the housing, could be satisfactorily replaced. The spun-over metal serving as a retainer ring frequently sheared off, thereby preventing a second swaging operation. When this occurred, the part was necessarily scrapped. Service men now can replace the bearing by merely staking the material in a different area around the perimeter. The original and two replacement stakings are possible, since the total length of the six stake indentations requires but one-third of the distance around the bearing perimeter.

It is estimated that staking will reduce to one-third the time formerly required by the spinning method, since both sides of the housings are staked simultaneously. Spinning required a series of continuous revolutions of the swaging tool, first on one side and then on the opposite side of the housing. The Glenn L. Martin Company.

High-Speed Gear Cutter

The Model 1843 Shear-Speed gear-cutting machine is designed for rough and semifinish cutting gears up to 4-in. diameter and 2-in. face width, producing spur and helical gears, involute splines, etc. It cuts all gear teeth around a gear blank's circumference simultaneously by means of radially fed form-tool blades having a shear-cutting action. The machine is capable of rough and semifinishing as many as 60 to 100 and even more gears per hour, depending on the job.

Such speed of production makes it possible for the speed of cutting gears to be brought up to the high level set by the modern gear-shaving machines that finish the pieces, so that production times for the rough cutting and the finishing processes can be equalized and predetermined. A unit composed of one Shear-Speed and one shaving machine is reported to produce continuously a definite quantity of gears per hour or per day, since the time of processing a gear on each machine is now approximately equal.

Operation is so nearly automatic that no particular skill is required. The gear blank is placed on the work holder. Pressing a button clamps the blank in cutting position and starts the machine, reciprocating the work against the cutter head. When correct size and shape have been attained, the machine returns to loading position and releases the semifinished gear for removal and reloading. The machine is so designed that the entire cutter-head assembly can be easily removed for sharpening blades or changing to another type of gear. Michigan Tool Company, Detroit.

Production-Control Record System

Various elements of control are secured by the visualizing and flow of multiple copies of a few forms that already are in use in most plants, and they may be combined to provide complete control.

"One-writing and visible filing" are combined in McCaskey control systems. The use of carbon-backed and other types of multicopy production forms makes accurate information available in several departments at the same time without rewriting, copying, or duplicating in any way. Controls are visualized by filing these forms—shop orders, time tickets, move tickets, etc.—on control boards according to simple procedures that make the desired information readily available. This filing is stated to be more rapid and accurate than posting the same information on cards or ledgers.

Advantages claimed by the manufacturer are (1) flow of finished parts, coordinated to prevent excessive or unbalanced inventories or assembly delays resulting from missing parts; (2) progress record showing immediate status of any or all orders at a glance and complete inventory of work-in-process; (3) machine scheduling, loading, and job assignment to keep all machines busy all the time and dispatch jobs in proper sequence; (4) forecast of delivery; (5) overdue orders eliminated or controlled; (6) prompt check of employees' production to assure realization of standards; (7) production follow-up without sole dependence on stock chasers; (8) day-by-day payroll and cost data for immediate control of unexpected increases; (9) control of material, purchased parts, parts produced, subassemblies, tools, supplies, etc. The McCaskey Register Company, Alliance, Ohio.

Interchangeable Type Holder for Marking Devices

For use with automatic roll marking devices, a new design of interchangeable type holder is reported to permit interchangeable type to be held in position more firmly than is usually possible. These results have been obtained by providing a wedge action in the assembly. This action is obtained by an angle groove in the marking dies, which mates with a beveled male ring on the insert retaining cover. A wedging action is thus obtained on the inserts which is not possible with the conventional square or rectangular groove. When small-sized type is used, the beveled groove helps to maintain strength inasmuch as less metal is removed with this design than with square or rectangular slots.

The wedging action is reported to be so strong as to make unnecessary the filling of the entire type opening with type or wedge blocks. This provides an increased degree of flexibility of the holder for marking parts interchangeably with either a small or large capacity of characters, reducing time for type changing and adjusting. New Method Steel Stamps, Inc., Detroit.

Standard Control Panel

A newly developed standardized control panel is designed to give American fighter pilots quick finger-tip mastery over the armament in all types of pursuit planes. Designed to eliminate confusion and errors in operation, and to simplify training and familiarization by pilots, the new panel has been developed by engineers of the U.S. Army Air Forces Air Technical Service Command and North American Aviation, Inc. It includes arrangement for machine gun, bomb, gun camera, chemical tanks, and rocket control switches. It will be standard on new designs in all aircraft and old designs will be changed wherever possible. The regulation panel will also make it easier to train mechanics and lessen the possibility of mistakes in servicing. North American Aviation, Inc.

Artificial-Limb Controls for Amputees Developed by Aircraft Builder

The present Northrop Control for actuating artificial limbs, which has been rigorously tested and has passed all tests with entire satisfaction, is now being supplied to the Army and Navy in substantial quantities. It consists of a $^1/_{16}$-in. diameter stainless-steel flexible aircraft cable, housed in a special flexible stainless-steel housing, and provided with lightweight terminal fittings and supports for attachment to the artificial hand and arm. It eliminates appreciable stretch or variation in control length with different arm positions; transmits 80 per cent of the applied force to the hand, and should give comparatively long wear. The several months of service completed to date have not progressed sufficiently to determine accurately what the life of the mechanism may be. When the eventual wear does occur, the only part requiring renewal will cost about 25 cents.

Charles McGonegal, field secretary of the American Legion, and a World War I bilateral amputee, has cooperated in the service testing of the Northrop Control, and has stated that he has developed new dexterity and can do many things never before possible in his 26 years' use of artificial limbs. McGonegal has volunteered as a "test pilot" of other improvements suggested by the Northrop group and now in the development and preliminary test stage.

One of the improvements now being developed is a method for making stump sockets of lightweight, high-strength plastic materials for use in fitting artificial lower limbs for below-knee amputees. This method, developed through the cooperation of the Northrop Process Laboratory and other Northrop personnel, and Swedlow Aeroplastics Corporation, cuts the time previously required to make these units to about one-tenth of the former period. In addition to the time saved, the plastic socket is reported to give a better fit, and is far more sanitary and durable than those made by previous methods. This technique is in experimental use at an Army hospital now and will be used elsewhere if it passes its service tests satisfactorily.

Another improvement now on test is in the wrist joint of the artificial arm.

WHEN MERCY SPEEDS ON WHIRLING WINGS

Flood, storm, forest fire or a major accident often maroons victims in inaccessible country, far from relief so urgent in saving lives.

Tomorrow's helicopters will find one of their most vital uses in such emergencies. They can go straight up or down, and fly swiftly forward. If it were necessary, they could even "*stand still in the air*", only a few inches above ground, to unload relief cargo, or take aboard ill or injured persons.

Under war stimulus, with Government encouragement, great strides have been made in the development of helicopters. They can serve a wide range of activities, from crop-dusting to exploration in regions where no other craft can land or take off. Kellett engineers have had an important part in this evolution. They are preparing now for the time when helicopters will perform many of the challenging tasks of peace, the world over.

THIS FREE BOOKLET TELLS YOU

If you wish to have more information about this new empire of "flight without wings," just write for "Answering Some Helicopter Questions". Kellett Aircraft Corporation, Dept. B, Upper Darby (Philadelphia), Pa.

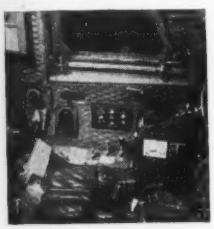
KELLETT

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

FIBERGLAS* Insulation Type XM-PF for Aircraft

Helped the "Commando" weigh-in lighter

The installation of Fiberglas Aircraft Insulation, instead of material formerly used, let the Curtiss C-46 Commando weigh in 200 pounds lighter.



View of pilot's compartment showing the inch-thick Fiberglas Insulation with diamond-quilted trim cloth.

Fiberglas Insulation, Type XM-PF is a lightweight, incombustible material. It is made of fine fibers of glass, bonded into a flexible blanket form. It has an exceptionally low moisture pick-up, even under conditions of extreme humidity. Fiberglas XM-PF weighs as little as one pound per cubic foot, yet provides an optimum of insulating effect.

It is easy to handle and install. And it requires no stitching or fitting to maintain its form and shape, even under extreme vibration. Fiberglas XM-PF Insulation serves a dual purpose in aircraft construction, providing a highly efficient acoustical and thermal insulation.

Helps the Airlines increase pay loads and comfort

Transports, released by the army for commercial service, are also being given the advantages of Fiberglas XM-PF, where weight reduction means bigger pay loads and customer comfort pays dividends.

Army transport being converted for civilian service by Douglas Aircraft Company, Inc.

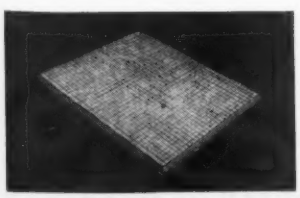
Fiberglas, in other forms, is being used by the military and commercial aircraft industry for both new construction and reconversion work. A few of the types and uses are listed below.

If you do not have complete data on Fiberglas in all of its various forms, or if you have a problem which Fiberglas may help solve, write: *Owens-Corning Fiberglas Corporation, 1893 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

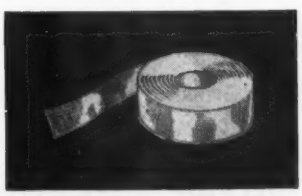
Buy War Bonds!

FIBERGLAS

*T. M. Reg. U. S. Pat. Off.



AIRCRAFT REINFORCED PLASTICS PARTS—fabricators are combining certain low-pressure resins with Fiberglas fabrics: Lightweight, impact strength, sound dampening. Used for panels and formed parts.



AIRCRAFT TAPES—another all-glass product, woven from Fiberglas yarns. Incombustible. Used for insulating motors, generators, etc., and for lagging of thermal insulation on ducts and pipes.

AIRCRAFT COATED FABRICS—Fiberglas cloth used as a base for rubber, vinyl compounds and other coatings. Dimensional stability, high strength, humidity resistance. Used in flexible connections, etc.

Some Day you will want

POLLAK MANUFACTURING COMPANY

Arlington, New Jersey

DEVELOPING • DESIGNING • MACHINE WORK • SPINNING
GAS AND RESISTANCE WELDING • STAMPING • ELECTRICAL WORK

Formerly any rotation of the artificial hand about the axis of the forearm was possible only by external means. The Northrop group has developed a new method whereby the forearm stump may be used adequately and effectively to control the rotation of the artificial hand, and great improvement in dexterity in eating, writing, and precision use of the hand has been achieved in the experimental models. The new wrist joint includes a locking device first suggested by Colonel Belknap, Commanding Officer of the Pasadena A.S.F. Regional Hospital, and perfected by Northrop, which locks the joint against externally applied loads, yet permits free rotation when initiated at the forearm stump.

Research is under way on a new elbow joint for above-elbow amputees, to improve control of the lower arm. New methods of applying other body movements to the control of the forearm and hand for upper-arm amputees also are under development. The upper-arm case is of particular interest, as no satisfactory method of control has been developed to date and the problems involved are such as to tax the ingenuity of the best mechanic and engineer.

The process developed for making plastic stump sockets for below-knee leg amputations has likewise been applied to all structural members of artificial upper arms, with the result that light, strong, durable, and sanitary units can be produced in quantity at low cost if and when the technical problems involved in the actuation and control of the artificial limb are fully solved. Consideration has been given to possible future improvements through the use of hydraulic and electronic control mechanisms, but such studies must wait for the day when more time and research facilities can be made available. Northrop Aircraft, Inc.

Radius Brake for Forming Metals

The Di-Acro radius brake was designed and developed at the request of aircraft manufacturers who required a precision machine capable of properly forming Duraluminum, chrome molybdenum, rust-resistant and spring-tempered alloys, and various other low-ductile materials essential in the fabrication and production of aircraft. This radius brake is intended to eliminate the possibility of fracture or disintegration developing at the line of forming while working on such materials. The radii obtainable with standard plates are $1/16$ in. to $3/16$ in., in increments of $1/32$ in. These are in accordance with the predetermined standards recommended by the U.S. Army Air Forces for aircraft construction.

The device is suitable for testing and determining ductile qualities of a wide variety of alloys and substances. It is adaptable for an almost unlimited range of laboratory and experimental research work, preparatory to selecting proper materials and developing the design of experimental or finished working models.

The Packless Metal Products Corporation's detachable flange for helical, flexible metal hose.

The maker states that all contact surfaces of the radius brake are adjustable in all planes and angles, making it possible to obtain a true radius over the entire material width at the point of forming, regardless of the degree of angularity, within the capacity of the unit, or any bend or type of material being worked. Precision adjustable stops are provided for holding to die tolerances the degree of angularity in all duplicated work. Adjustment bolts are provided with lock screws. Main bearings are of cold-rolled steel to gray iron, adjustable for wear and alignment. The contact surfaces are removable for changes or replacements.

Accuracy is guaranteed by the manufacturer to a tolerance of 0.011 in. in all duplicated work. Specifications are as follows: Maximum folding width, 12 in.; maximum full width folding capacity, 16-gage steel plate, with heavier gages of narrower or more ductile materials in proportion; maximum degree of angular folding, 110°. O'Neill-Irwin Manufacturing Company, Minneapolis.

Detachable Flange for Flexible Metal Hose

A detachable flange for helical flexible metal hose, in sizes 2-, $2\,1/2$- and 3-in. inside diameter, is so designed as to permit repeated re-use. The assembly operation is carried out with ordinary shop tools. No brazing is required. No gasket is employed to connect the flange to the hose, making a metal-to-metal seal. The maker states that the construction ensures a positive leak-proof installation. Packless Metal Products Corporation, New Rochelle, N.Y.

Aircraft Brake Intensifier

The Univac aircraft brake intensifier was designed to provide faster braking action and lower pedal pressures for power braking on airplanes. A more responsive "pedal feel" is intended to give the pilot more accurate control for ground maneuvering. Its purpose is to provide a powerful instantaneous brake effort that is always proportional to the physical effort applied. Not only does the brake action correspond to pressure on the pedal, but because of the "pedal feel" it can be governed by the pilot. With this self-contained unit, a balanced action without exterior reaction is provided. No structural reinforcements are required other than the brackets supporting the brake intensifier in position.

The brake intensifier was designed for installation in medium-sized aircraft in which the straight hydraulic operation of the brakes requires effort of the pilot. On some special installations using several units, the system can be applied to aircraft weighing as much as 30,000 lbs. These units, weighing approximately 5 lbs. each, may be installed in any location on the airplane between the master cylinder and the wheel brake.

The device consists of a vacuum-suspended piston that is used to operate a hydraulic-pressure piston placed in the brake line between the master cylinder and wheel brake. A valve incorporated in the vacuum-suspended piston shuts off the vacuum and admits air to one side, creating a pressure differential. This sets the pistons in motion, intensifying the pressure in the hydraulic lines. The valve is operated by the hydraulic pressure from the master cylinder which the pilot actuates. The intensified pressure is prevented from returning to the master cylinder by means of a hydraulic valve placed between the master cylinder input and the pressure piston. This hydraulic valve, however, permits manual operation of the brakes when power is not available.

The hydraulic operation of the air valve is so designed that a constant ratio is maintained between input and output pressures of the unit. Pesco Products Company, Division of Borg-Warner Corporation.

Signal and Communication Relay

Weighing only $1\,3/4$ oz., the R-B-M Type 23000 signal and communication relay, originally designed for aircraft service, is now being used extensively in air-borne radio transmitters and receiving sets.

Specifications include six normally open contacts; contact rating, 3 amps. d.c. noninductive; vibration resistance up to 10 g at 40,000 ft.; temperature ranges, −65°C. to +85°C.; approximate dimensions, $2\,1/16$ in. long, $1\,1/2$ in. high, $7/8$ in. wide. It is available also in other arrangements of normally open and normally closed contacts. Design and construction are stated to meet Signal Corps requirements for resistance to humidity, salt spray, and fungus.

The magnet coil bobbin is of high-impact, specially molded phenolic material of high insulating value, resistant to electrolysis, and capable of withstanding severe humidity. The entire contact pile-up assembly is baked 100 hours at 230°F. as a regular part of the manufacturing process. After the baking operation, all screws are retightened, and contacts are aligned and pointed.

This type of relay is available also with heavy duty contacts rated at 10 amps., 28 volts d.c. noninductive.

Facts About the "Mars"
Pounds of Aluminum 60,000
Pounds of Steel (including engines) 23,000
Pounds of other metals 2,000
Weight of wing . . . 20,000
Weight of hull 21,500
Number of rivets . . 1,500,000
PITTSBURGH
AIRCRAFT
FINISHES

Pittsburgh Paint Flies with the "MARS"

THERE can be no better proof of the stamina, long life and protective qualities of Pittsburgh Industrial Finishes than their remarkable performance under the conditions in which the "Mars"—world's largest flying boat—has to operate.

This gigantic craft of the U. S. Navy needs more than one hundred gallons of zinc chromate primer to protect her metal parts against the corrosions of salt air and spray.

Her fabric surfaces are covered with eighty gallons of nitrate dopes—clear dope to tighten the fabric and pigmented dope for final color coats.

Pittsburgh takes pride in the fact that these products are assisting Navy fliers to perform their hazardous missions the world over.

We'll be glad to consult with you on your problems. Our extensive experience in the field of aircraft finishes often can save you time and money.

Pittsburgh Aircraft Finishes

Camouflage Finishes . . . Protective Coatings for Wood and Fabric Surfaces . . . Zinc Chromate Primers for Metal . . . Lacquers, Clear and Pigmented . . . Dopes, Clear and Pigmented . . . Sealers and Surfacers for Wood . . . Plywood Finishes . . . Paints . . . Spar Varnishes . . . Heat-Resisting Enamels . . . Slushing and Sealing Compounds for Fuel Tanks . . . Caulking and Glazing Compounds . . . Chromseal Ribbon Compound . . . Fabseal Impregnated Tape . . . Chromseal Tape . . . Stratoseal Cabin-Sealing Tapes . . . Army and Navy Specification Finishes . . . Commercial Finishes for Post-War.

PITTSBURGH PLATE GLASS COMPANY, Industrial Paint Division, Pittsburgh, Pa. Factories: Milwaukee, Wis.; Newark, N. J.; Houston, Texas; Los Angeles, Calif.; Portland, Ore. Ditzler Color Division, Detroit, Mich. The Thresher Varnish Co., Dayton, O.

PITTSBURGH *Industrial* FINISHES

PITTSBURGH STANDS FOR QUALITY PAINT AND GLASS

R-B-M Manufacturing Company, division of Essex Wire Corporation, Logansport, Ind.

Control Timer Equipped with Synchronous Motor

The new Reco control timer was designed for controlling manufacturing operations in which starting is initiated by a momentary-contact push button, stopping automatically at a preset time. The timer can also be equipped with interlocking controls so that each operation must be completed in correct sequence before the next is started. Failure at any point would post a signal and the timer would recycle automatically to starting position.

One of the many possible applications of the timer is as a hydraulic-press control in which pressure valves are shut off upon reaching a certain tonnage, holding the pressure for a predetermined time, and signaling the operator.

The timer is equipped with silver contacts and has a two-circuit control. It has a synchronous motor for operating on 115-v., 60-cycle a.c. power. However, when desired it can be equipped with additional circuits and arranged for other current specifications. Reynolds Electric Company, Chicago.

Viscosity Index Improver for Hydraulic and Recoil Oils

Acryloid HF is an organic compound intended to prevent dangerous thickening of aircraft hydraulic oils at sub-zero temperatures or excessive thinning in tropical heat. By combining this new material with the selected oils a fluid condition is maintained in hydraulic systems under the temperature extremes encountered in military operations.

With aircraft that climb from tropical temperatures to the stratosphere in a few minutes the material functions as the means of adjusting the oil to the rapid temperature changes. The manufacturer is issuing royalty-free licenses to oil companies enabling them to produce new types of hydraulic oils, hydraulic fluids, and lubricating oils. The Rohm & Haas Company, Philadelphia.

New Aeronautics Lecture

First details have been announced of a new British lecture in aeronautics, founded by The Royal Aeronautical Society, which is expected to rank in importance with the Wilbur Wright Memorial Lecture. It is to be known as the "British Empire Lecture," and speakers will be selected alternatively from Great Britain and the Empire Overseas.

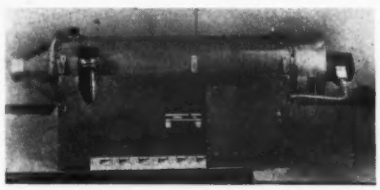
The new lecture will be given annually in London, and each lecturer will receive a fee of £50. In the case of a speaker from overseas a bounty of £100 will be provided toward travel expenses.

The Council of The Royal Aeronautical Society is anxious that the British Empire Lecture provide a prominent means for the promulgation of new ideas in aeronautics. Subjects will therefore be selected not only for their technical interest but also for their general concern to all in aviation.

The first lecture is scheduled to take place in September, 1945, and the names of possible speakers are now being invited by the secretary of the society at 4, Hamilton Place, London, W.1. Other things being equal, it is hoped that the first lecture will be given by a speaker from the Empire Overseas. The Society of British Aircraft Constructors Ltd.

Correcting a Possible Misunderstanding

An item appearing on page 167 of the February, 1945, issue of the AERONAUTICAL ENGINEERING REVIEW headed "Development of British Spark Plugs" was based on information from The Society of British Aircraft Constructors Ltd. It praised the development of superior types of spark plugs to which were credited a great improvement in the life of the plugs and in the performance of combat airplanes, making frequent reference to one of the leading makers of British spark plugs. The Society has issued a supplementary release to correct any possible misunderstanding to the effect that this was the accomplishment of any one company. It was the achievement of all organizations engaged in the work, including aircraft-engine manufacturers, producers of ceramic compounds, the metallurgic laboratories of chemical companies, and the three British manufacturers of spark plugs. The Society of British Aircraft Constructors Ltd.



The new portable self-contained Janitrol aircraft heater.

Portable, Lightweight Aircraft Heater

Designed primarily for use in hospital aircraft, a new portable Janitrol aircraft heater is applicable to heating helicopters, preheating airplane engines, and for other uses in and after the war.

The portable feature is reported to be new to aircraft heating. The need for such a unit, which can be easily installed and removed, arose when cargo craft whose original design did not include heat for the cargo space were used as hospital planes.

The new heater is self-contained except for motive power, weighs less than 38 lbs. and has a heat output of 40,000 B.t.u. per hour. In performance the unit more closely approaches a 125,000-B.t.u. heater because it takes air for operation from the cabin rather than having to raise the temperature of colder outside ram air.

The fact that no outside air is needed to operate the heater is what makes it especially suitable for helicopters. Motion of the aircraft is not necessary for the heater's operation, from ground level to its 15,000-ft. ceiling. To put the heater into operation simply requires plugging to an electric connection and manipulating the switch. High-, medium-, and low-heat operation is obtained by a fuel-control switch. The fully automatic control system could be operated by a thermostat if desired. A $3\frac{1}{2}$-gal. fuel tank is built into the heater and is sufficient for 8 hours' continuous operation. The unit also has its own fuel pump driven by a small motor and a circulating-air fan driven by a $\frac{1}{2}$-hp., 24-volt motor.

These features of independent operation distinguish the new heater from the present Janitrol aircraft heater. The new unit is not expected to replace the present aircraft heater on planes that regularly require heat or on those flying at altitudes above 15,000 ft. The manufacturer states that the portable unit could be removed from the plane and used for preheating of the engine in the event of a forced landing in cold weather. Since it can be used entirely away from the airplane, the unit could also provide heat for a hangar or in any number of other locations. Surface Combustion, Toledo, Ohio.

Twist-Drill Sharpening Jig

The E-Z drill grinder for sharpening twist drills is a simple jig that can be set up quickly on a grinder frame or on a bench adjacent to the grinding wheel. It has been simplified to the point where only a few standard motions produce a satisfactory finish on a dull drill in less than $\frac{1}{2}$ min., even when done by an inexperienced worker.

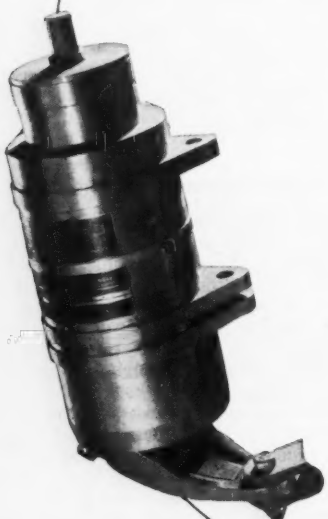
The grinder has a new protractor feature that enables it to be set quickly for three different drill-point angles, depending upon the hardness of the material on which the twist drill is to be used. The jig is designed to hold drills up to 11 in. long and $\frac{3}{32}$ to $1\frac{1}{16}$ in. diameter. Fred F. Ten Eyck, Los Angeles.

Carrier System for Testing Work

A carrier system for use with dynamic pressure gages and other instruments to measure static and dynamic pressures, acceleration, torque and strain, clearance between moving parts, angular position, and vibration, is designed particularly for aircraft test work. It is suitable for tests involving boundary-layer studies, airfoil pressures, and other specialized applications; internal-combustion induction-system pressures; and for general industrial use. The system is available in two series, one making use of the modulated carrier-wave principle, while the other employs a discriminator circuit. Frequency ranges are as high as 10,000 cycles per sec. The power supply and oscillator can be supplied in any number of channels required.

An example of the design is found in the construction of the amplifiers.

HOUDAILLE*—the Shimmy "Doctor"



● Newest military cargo aircraft which is revolutionizing the movement of men and materials to the fronts in World War II is the Fairchild Packet C-82. This twin-engined 25-ton giant has been nicknamed "the flying boxcar" because of its radical fuselage and great carrying capacity. Two huge barn-like doors at the stern permit heavy vehicles to drive in.

In common with other tricycle landing gear craft, the C-82 has a nose wheel which, if uncontrolled, could shimmy violently and make landings and take-offs extremely hazardous. Houdaille engineers "doctored" this trouble readily with the Houdaille Hydraulic Shimmy Damper which is safeguarding the most famous American fighters, bombers and cargo planes.

Just as the Fairchild Packet will find many peacetime uses, so will Houdaille's broad experience in hydraulics solve many postwar problems in the aviation, automotive and railroad fields.

HOUDE ENGINEERING DIVISION OF
HOUDAILLE-HERSHEY CORPORATION
MAKERS OF HYDRAULIC CONTROLS
Buffalo 11, New York

*Pronounced—Hoo-dye

MANUFACTURERS OF PRECISION PARTS AND EQUIPMENT FOR THE AUTOMOTIVE . . . AIRCRAFT . . . RAILWAY . . . MARITIME . . . ELECTRIC REFRIGERATION . . . RADIO AND OTHER INDUSTRIES

Each channel is supplied with an individual oscillator. This makes possible not only the setting of individual channels at different frequencies, should the need arise, but also allows for greater overall accuracy. Specifically, should a gage or network fail in the system, the other channels are unaffected by such change.

Any one of a number of gages is used as a primary element, or pickup, and a cathode-ray oscillograph or recording oscillograph or other suitable recording or indicating equipment can be used with the carrier system to indicate or record the measurements taken. Indicator cards on internal-combustion engines, Diesel engines, and pumps or compressors can be made when the system is used with recording equipment. Other applications include cylinder-head pressures, manifold pressures, blower-rim and supercharger pressures, fuel-system pressures, air-scoop pressures, impact loads on hulls, and landing-gear shock loads. Trimount Instrument Company, Chicago.

"Convertible" Boring Tools

"Convertible" carbide-tipped and solid carbide boring tools are recommended by the maker for use where facilities are available for finish-grinding the edges to desired shapes. These tools are made in two styles, with a flat top or a back-rake tip. Each is available in four sizes ranging from $^5/_{16}$ to $^1/_2$-in. in diameter.

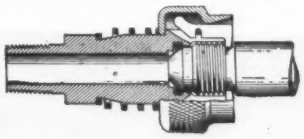
The solid tools, which come with the outside diameter finish-ground, are offered in sizes ranging by $^1/_{32}$-in. steps from an outside diameter of $^3/_{32}$ in. and a length of $^3/_8$ in. to an outside diameter of $^1/_4$ in. and a length of 1 in. Tungsten Carbide Tool Company, Detroit.

Flight-Instruction Motion Picture

To give the American public an idea of how easy it is to fly, a short motion picture shows the sales manager of the Aeronca Aircraft Corporation teaching youngsters to fly. In the picture instructions are given to children ranging in age from 5 to 12. The film, *Wingmen of Tomorrow*, will be shown at motion-picture theaters throughout the country.

This sort of picture is intended to popularize flying with that large section of the American public that thinks it is difficult. The picture begins with elementary lessons as the youngsters are shown how to handle the controls of a plane. The next step is with models of light airplanes to acquaint the pupils with ailerons, sticks, struts, rudders, and fins.

Lint swatches attached to the tail demonstrate the action of air flowing over plane surfaces. This is part of the basic instruction given in the theory of aerodynamics, explaining how heavier-than-air-craft can be lifted off the ground and how their flight is sustained and controlled. Then the workings of an internal-combustion engine are explained. Following this ground-school instruction each pupil is taken for a flight in a training plane. The commentary of the picture explains in detail how easily these youngsters have learned to fly. Universal Pictures Company, Inc.



The Wiggins direct-connect coupling.

Direct-Connect Coupling

The Wiggins Direct-Connect coupling is specially adapted for use in testing operations in the manufacture of aircraft carburetors, metering gages, valve gages, and hydraulic equipment. It fits over the end of any standard type AND 10056 nipple, the "dogs" of the coupling gripping securely in the undercut just behind the threads of the nipple, to connect any fluid or air line.

The coupling is made of aluminum. It fits all standard type AN nipples with the undercut and since these are available with or without the undercut, the former can be installed when reordering nipples. It is available in sizes of $^1/_4$ in., $^5/_{16}$ in., $^3/_8$ in., $^1/_2$ in., $^5/_8$ in., and $^3/_4$ in. E. B. Wiggins Oil Tool Company, Inc., Los Angeles.

Aircraft Fire Detector

The Wilcolator aircraft fire detector consists of a high-expanding alloy steel casing approximately 3 in. long by $1^1/_2$ in. wide by $^3/_4$ in. thick. This casing is spot-welded to a stainless-steel mounting plate for convenient mounting to the fire wall or diaphragm.

The casing encloses an alloy-steel snap blade of a different coefficient of expansion than that of the case. When the outside casing is heated rapidly, as in case of fire, the expansion of the casing causes the snap blade to make contact and indicate that a fire has occurred. When the rate of heating is slow, the casing and blade heat at approximately the same rate, with the result that the switch closes at a temperature above the normal ambients encountered, and, under this condition, would indicate a dangerously high ambient temperature. When the fire has been extinguished or the cause of the high temperature removed, the switch automatically snaps open and is ready for the next operation. The Wilcolator Company, Elizabeth, N.J.

New Seven-Cylinder Power Plant Using Inexpensive Low-Octane Fuel

Specifically designed to provide airframe manufacturers with an air-cooled radial engine in a power range not provided by designers during the past 8 years, a new seven-cylinder aircraft engine uses inexpensive low-octane fuel and develops 700 hp. Prototype models of the Cyclone 7, test-flown in standard aircraft, are said to have demonstrated satisfactory power output, fuel economy, and smoothness of operation.

Basically, this engine is the latest model of the Cyclone series of air-cooled radial aircraft engines but it has seven cylinders instead of nine and its combustion-chamber design is appropriate for gasoline of an octane rating considerably lower than that used by combat or present transport planes. Horsepower output would be correspondingly greater with the use of the highest octane fuels. However, it is claimed that interchangeability of many parts of the nine-cylinder and seven-cylinder types is possible, simplifying maintenance problems and enabling more economical manufacture.

The Cyclone 7 makes use of forged cylinder heads for greater strength and ruggedness. Providing an efficient cooling factor, the new cylinder assemblies embody longer valve guides, greater cooling-fin area in the vicinity of exhaust-valve guide bosses, and a self-aligning exhaust-valve seat to insure proper alignment of the valve. Barrels of cylinders incorporate aluminum fins for improved cylinder-barrel cooling; this is credited with assuring longer piston-ring life and improved piston lubrication.

A valve-gear lubrication system that makes use of a series of external oil tubes to increase the lubrication of valves is said to result in longer valve life and reduced cylinder maintenance. To improve lubrication within the engine, oil jets have been provided in the engine's crankcase to direct a continuous flow of oil into each cylinder barrel.

The Cyclone 7 is provided with a two-speed supercharger drive. The higher supercharger ratio, 8.686:1, is cited as adequate for development of maximum engine power at high-altitude airports. The lower supercharger ratio, 7.208:1, is recommended by the builder for use in supplying extra power for high performance at low-altitude airports. Wright Aeronautical Corporation.

Hydraulic Piston Ring and a Motor-Generator Unit

Two recent developments for the aircraft industry are the Wyse AN-6231 wiper ring for use in the cylinders of hydraulic systems, and the MG-39 portable motor-generator. The ring is featured by a slotted construction about the periphery for added flexibility, and by scraping tension derived from a garter spring for breaking ice inside the cylinder and scraping away mud, sand, or other foreign matter.

The motor-generator is suitable for testing aircraft instruments. It has an input rating of 900 watts, 115 volts, 60 cycles, and output of 55 watts at $27^1/_2$ volts d.c. and 230 volt-amp. at 115 volts, 400 cycle a.c., either separately or simultaneously. The manufacturer states that the limits of operating variations exceed A.A.F. specifications. Wyse Laboratories, Dayton, Ohio.

Military overloads land

more safely on nylon tires

Even Boeing's Superfortress has increased its bomb load with stronger B. F. Goodrich tires

NYLON CORDS make better airplane tires for military planes because they are stronger, and because, for the same load capacity, they are lighter.

In most cases today, nylons weigh almost the same as tires made with rayon. But that is because, instead of being made smaller to carry the same load formerly carried by rayon cord tires, they are made in the same size, and the loads carried are increased.

While the established "ratings" for nylon tires have not been changed, the "service loads" actually carried in many military operations have been calculated and show increases of 22% to 57% above the ratings. B. F. Goodrich engineers rate nylons at least 25% stronger for the same number of plies.

Today, all 56-inch tires are made with nylon. In fact, at least 75% of all military tires are now converted to nylon, and other conversions are being set up to raise this figure to at least 95% within a matter of weeks.

How nylon increases "payload" in tires

The air in the tire carries the load. Nylon cords of equal size have a tensile strength of between two and three times that of cotton cords, and nearly double that of rayon cords. So with stronger nylon, the air pressure can be increased and the load increased in proportion.

Other factors contribute to longer service life

Fewer tires made with nylon are removed from military service because of bruising than was ever true with rayon cord tires. Nylon lasts longer, too, because of its greater fatigue resistance. Fatigue tests of tire cords under equivalent operating conditions and at 300° F. showed that rayon lasts three times as long as cotton, and nylon eight times as long. The B. F. Goodrich Company, Aeronautical Division, Dept. F4, Akron, Ohio.

All made by B.F. Goodrich

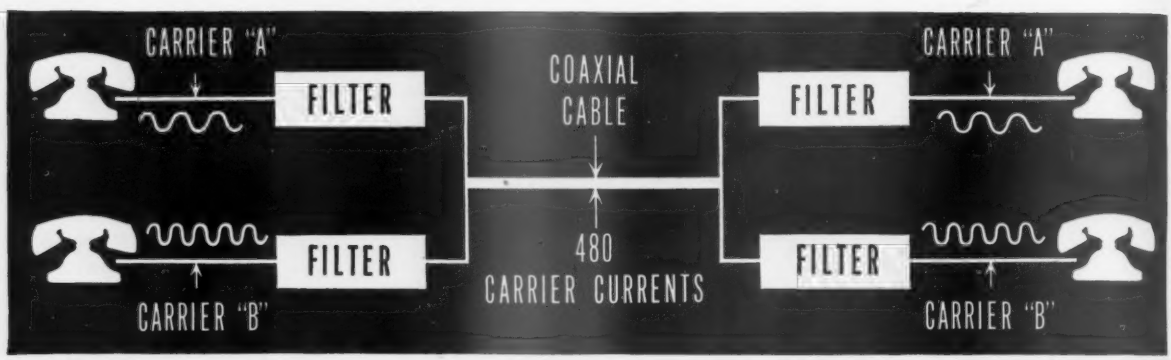
Expander tubes for brakes · Propeller anti-icers · De-icers · Grommets · Engine mounts · Hydraulic and Fuel hose · Control seals · Pressure-sealing zippers

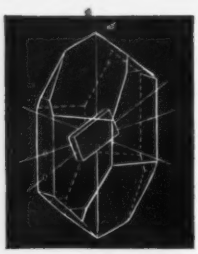
Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

Crystal gateways for your voice





Four hundred and eighty telephone conversations over a coaxial cable was one of the last peacetime achievements of communication research in Bell Telephone Laboratories. In this multi-channel telephone system, each conversation is transported by its own high-frequency carrier current. At each end of the line are crystal gateways; each opens in response to its own particular "carrier" with the message it transports. In telephone terminology, these gateways are filters.

The ultra-selective characteristic of these filters is made possible by piezo-electric quartz plates, cut in a special manner from the mother crystal, and mounted in vacuum. Each set of plates is precisely adjusted so that the filter responds only to the frequency of its assigned channel, rejecting all others. In the coaxial terminal equipment, such crystal gates sort out messages for delivery to their four hundred and eighty individual destinations.

In recent years, Bell Telephone Laboratories research has provided the Armed Forces with many types of electrical equipment in which frequency is controlled by quartz crystals. Notable is the tank radio set which enables a tank crew to communicate over any one of 80 different transmission frequency channels by simply plugging in the appropriate crystal. The future holds rich possibilities for the use of quartz crystals in Bell System telephone service.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in telephone service.

Source Material

For the information of readers, the following lists the periodicals, house organs, and other publications regularly received and reviewed.

The prices listed are for single issues and yearly subscriptions to recipients in the United States. Subscription prices to house organs are in many cases not available but may be obtained directly from the offices of the organization.

The frequency of publication is indicated by the following symbols: M, monthly; SM, semimonthly; BM, bimonthly; W, weekly; BW, biweekly; D, daily; Irreg., irregularly; Q, quarterly.

Periodicals

Aero Digest, 515 Madison Ave., New York 22, N.Y., SM, $0.50, $3.00.

The Aero Field, Francis J. Field, Ltd., Sutton Coldfield, England, 10 issues per year, 6*d*., 5*s*.

Aero Products, 271 Madison Ave., New York 16, N.Y., M.

Aeronáutica, Avda. de Mayo 1370, Buenos Aires, M, $0.60 (pesos), $4.50 (pesos).

Aeronautics, Tower House, Southampton St., Strand, London, W.C.2, M, 2*s*., 26*s*. 6*d*.

The Aeroplane, Bowling Green Lane, London, E.C.1, W, 1*s*., 58*s*.

The Aeroplane Spotter, Bowling Green Lane, London, E.C.1, BW, 3*d*., 8*s*. 8*d*.

Air Age Education News, Air Age Education Research, 100 E. 42d St., New York 17, N.Y., BM.

Air Facts, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.25, $3.00.

Air Mail Magazine, A. Phillips, Newport, Monmouthshire, M, 4*d*., 5*s*.

Air News, 545 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

Air Pilot and Technician, 515 Madison Avenue, New York 22, N.Y., M, $0.35, $3.00.

Air Tech, 545 5th Ave., New York 17, N.Y., M, $0.25, $2.50.

Air Trails Pictorial, 122 E. 42d St., New York 17, N.Y., M, $0.25, $2.50.

Air Transport, 330 W. 42d St., New York 18, N.Y., M, $0.50, $5.00.

Air Transportation, 10 Bridge St., New York 4, N.Y., M, $0.50, $5.00.

Air World, 241 Church St., New York 13, N.Y., BM, $0.15, $0.90.

Aircraft, 62 Flinders St., Melbourne, C.1, M, 1*s*. per issue.

Aircraft Engineering, 12 Bloomsbury Sq., London, W.C.1, M, 2*s*. 3*d*., 26*s*.

Aircraft Production, Dorset House, Stamford St., London, S.E.1, M, 2*s*. 6*d*., £1 14*s*. 6*d*.

Airlanes, 340 W. 57th St., New York 19, N.Y., M, $0.25, $2.50.

Airmail Digest, Charles B. Charmatz, Sylvania, Ohio, Irreg.

Airports, 1170 Broadway, New York 1, N.Y., M, $0.25, $3.00.

Aluminum and Magnesium, 425 W. 25th St., New York 1, N.Y., M, $3.00 yr.

American Aviation, American Bldg., Washington 4, D.C., SM, $0.25, $4.00.

American Aviation Daily, American Bldg., Washington 4, D.C., D, $170 yr.

American Aviation Directory, American Bldg., Washington 4, D.C., Semi-annually, $5.00, $7.50.

American Aviation Traffic Guide, 139 N. Clark St., Chicago 2, Ill., M, $0.50, $5.00.

The American Mercury, 570 Lexington Ave., New York 22, N.Y., M, $0.25, $3.00.

Automotive and Aviation Industries, Chestnut & 56th Sts., Philadelphia 22, Pa., SM, $0.25, $1.00.

Avia, Victoria 788, Buenos Aires, M, $0.50 (*m/n*), $5.00 (*m/n*).

Aviação, Rua Uruguiana, 104, Rio de Janeiro, M, $4.00 (cruzeiros), $40 (cruzeiros).

Aviación, 429 H. W. Hellman Bldg., Los Angeles 13, Calif., BM, $1.00 yr.

Aviation, 330 W. 42d St., New York 18, N.Y., M, $0.50, $3.00.

Aviation and Yachting, 2816 Eaton Tower, Detroit 26, Mich., M, $0.25, $2.00.

Aviation Equipment, 1170 Broadway, New York 1, N.Y., M.

Aviation Maintenance, 205 E. 42d St., New York 17, N.Y., M, $0.50, $5.00.

Aviation News, 1357 National Press Bldg., Washington 4, D.C., W, $0.50, $5.00.

Aviation Review, 31 Willcocks St., Toronto 5, Ontario, M, $0.25, $3.00.

Aviation Service Magazine, 549 W. Washington Blvd., Chicago 6, Ill., BM.

British Plastics, Dorset House, Stamford St., London, S.E.1, M, 1*s*. 6*d*., 20*s*.

Canadian Air Cadet, 122 Wellington St., Ottawa, Ontario, M, $0.10, $1.00.

Canadian Aviation, 481 University Ave., Toronto 2, Ontario, M, $0.25, $2.00.

Chile Aéreo, Club Aéreo de Chile, Av. Bulnes 80, Santiago de Chile, M, $5.00 (pesos), $50 (pesos).

Collier's, The Crowell-Collier Publishing Co., Springfield, Ohio, W, $0.10, $3.00.

Commercial Aviation, 341 Church St., Toronto, Ontario, M, $0.25, $3.00.

Contact, 113 W. 42d St., New York 18, N.Y., M, $0.20, $2.00.

Current Aviation, 400 S. Front St., Columbus 15, Ohio, W, $0.80 yr.

D and W, 100 E. 42d St., New York 17, N.Y., M, $0.30, $3.00.

Diesel Power & Diesel Transportation, 192 Lexington Ave., New York 16, N.Y., M, $0.35, $3.00.

EMCO Monthly Journal, Marks Stamp Co., Ltd., 258 College St., Toronto 2, Ontario, M, $0.50 yr.

The Engineer, 28 Essex St., Strand, London, W.C.2, W, 1*s*., £3 3*s*.

Engineering, 35 Bedford St., Strand, London, W.C.2, W, 1*s*. 2½*d*., £3 3*s*.

Engineering Materials and International Power Review, Africa House, Kingsway, London, W.C.2, BM, 3*s*., 15*s*.

Engineering News-Record, 330 W. 42d St., New York 18, N.Y., W, $5.00 yr.

The Engineers' Digest (American Edition), 1 Madison Ave., New York 10, N.Y., M, $0.75, $7.50.

Flight, Dorset House, Stamford St., London, S.E.1, W, 1*s*., £3 1*s*.

Flying, 540 N. Michigan Ave., Chicago 11, Ill., M, $0.35, $4.00.

Flying Aces, 67 W. 44th St., New York 18, N.Y., M, $0.15, $1.80.

Gliding, 4658 Portage Rd., Kalamazoo 85, Mich., M, $0.25, $3.00.

Heating and Ventilating, 148 Lafayette St., New York 13, N.Y., M, $0.30, $2.00.

Indian Aviation, 13 Ezra Mansions, P.O. Box 2361, Calcutta, India, M, 8 annas, 7 rupees 8 annas.

Industrial Aviation, 540 N. Michigan Ave., Chicago 11, Ill., M, $2.00 yr.

Industrial Engineering, 416 Wall St., Los Angeles 13, Calif., M, $2.00 yr.

Industrial Standardization, American Standards Assn., 70 E. 45th St., New York 17, N.Y., M, $0.35, $4.00.

Instruments, 1117 Wolfendale St., Pittsburgh 12, Pa., M, $2.00 yr.

International Aviation (Foreign News Supplement to American Aviation Daily), American Building, Washington 4, D.C., W, $100 yr.

Iron Age, 100 E. 42d St., New York 17, N.Y., W, $0.35, $8.00.

Kunststoffe, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $15 yr.

Light Metals, Bowling Green Lane, London, E.C.4, M, 1*s*. 6*d*., 20*s*.

Luftfahrtforschung, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $12 yr.

Machine Design, Penton Bldg., Cleveland 13, Ohio, M, $0.50, $6.00.

Machinery, 148 Lafayette St., New York 13, N.Y., M, $0.40, $4.00.

Mechanix Illustrated, 1501 W. Broadway, New York 18, N.Y., M, $0.15, $1.80.

Metals and Alloys, 330 W. 42d St., New York 18, N.Y., M, $0.25, $2.00.

The Military Surgeon, Army Medical Museum, Washington 25, D.C., M, $0.50, $4.00.

Model Airplane News, 551 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

Modern Plastics, 122 E. 42d St., New York 17, N.Y., M, $0.50, $5.00.

Modern Transport, 105–109, Strand, London, W.C.2, W, 3*d*., 20*s*.

Mundo Aeronáutico, Rivadavia 945, Buenos Aires, M, $0.30 (pesos), $4.00 (pesos).

The N.A.T.A. Dispatch, National Aviation Trades Assn., 214 E. Armour Blvd., Kansas City 2, Mo., 36 issues per yr.

Official Aircraft Price Guide, Aircraft Advisory Service, Inc., P.O. Box 81, Columbus 16, Ohio, Q, $6.50 yr.

The Official Foreign Air Mail Guide, 11 W. 42d St., New York 18, N.Y., M, $1.50 yr.

The Official Guide of the Airways, 608 S. Dearborn St., Chicago 5, Ill., M, $0.50, $5.00.

Pacific Plastics, 124 W. 4th St., Los Angeles 13, Calif., M, $0.30, $3.00.

Plastics, 540 N. Michigan Ave., Chicago 11, Ill., M, $5.00 yr.

Plastics, Bowling Green Lane, London, E.C.1, M, 1*s*. 6*d*., 19*s*.

Plastics and Resins, 299 Madison Ave., New York 17, N.Y., M, $0.35, $3.00.

Plastics Reporter, 1214 Hyde Park Ave., Hyde Park 36, Mass., M, $0.20, $2.00.

Plastics World, 551 5th Ave., New York 17, N.Y., M, $0.25, $3.00.

Popular Mechanics Magazine, 200 E. Ontario St., Chicago 11, Ill., M, $0.25, $2.50.

Popular Science Monthly, 353 4th Ave., New York 10, N.Y., M, $0.25, $2.50.

Product Engineering, 330 W. 42d St., New York 18, N.Y., M, $0.50, $5.00.

Production Equipment, 328 S. Jefferson St., Chicago 6, Ill., M.

Protar, Buchdruckerei Vogt-Schild AG., Solothurn, M, 1.00 Sw. Fr., 15 Sw. Fr.

Recent Periodical Articles, Library, Parks Air College, Inc., E. St. Louis, Ill., M, $5.00 yr.

Revista Aérea Latinoamericana, 515 Madison Ave., New York 22, N.Y., M, $0.15, $1.00.

Revista do Ar, Aero Clube de Portugal, Av. da Liberdade, 226, Lisboa, M, 120$00.

România Aeriană, Calea Floreasca Nr. 13, Bucharest, M.

Rutas del Aire, Melincué 2501, Buenos Aires, M, $0.30 (*m/n*), $3.50 (*m/n*).

The Saturday Evening Post, Independence Sq., Philadelphia 5, Pa., W, $0.10, $6.00.

Schweizer Aero-Revue, Hirschengraben 22, Zürich, M, 80 Rappen, 10 Sw. Fr.

Science Illustrated, 33 W. 42d St., New York 18, N.Y., M, $0.25, $3.00.

Scientific American, 24 W. 40th St., New York 18, N.Y., M, $0.35, $4.00.

Sheet Metal Industries, 49, Wellington St., London, W.C.2, M, 1*s*. 3*d*., 15*s*.

Skyways, 444 Madison Ave., New York 22, N.Y., M, $0.25, $3.00.

Southern Flight, 1901 McKinney Ave., Dallas 1, Tex., M, $0.25, $2.00.

Steel Processing, 108 Smithfield St., Pittsburgh 30, Pa., M, $0.25, $2.50.

NORTH AMERICAN JOINS FAIRCHILD IN PRODUCING THE PACKET

AMERICAN air power, the mightiest on earth, was built by teamwork with American industry. Into our ships of the air go the efforts of manufacturers and suppliers great and small.

The Fairchild "Packet," the Army's newest and most efficient carrier of air cargo, was built by this kind of teamwork: The teamwork of the Army with Fairchild designers and engineers, Fairchild sub-contractors, builders of engines, suppliers of metals, the sub-assemblers and fabricators of myriad parts and materials!

Now the Army Air Forces have designated North American Aviation, Inc., as another builder of "the flying boxcar." Fairchild welcomes this newest member of the "Packet"-building team, famed for the B-25 Mitchell Bomber; the superlative fighter, the P-51 Mustang; and the AT-6 Texan.

Soon the "Packet" will be coming down the runways from both Fairchild and North American.

Fairchild engineering and design built these features into the "Packet":

- The ability to carry a nine-ton load in cargo or men and equipment.
- A range in excess of 3,500 miles.
- A cargo capacity of 2,312 cubic feet—about 88% of a standard boxcar's capacity.
- Space for 42 paratroopers and their equipment; rear end jump doors that deliver them "in the clear."
- Special doors in the belly, through which a paratrooper's equipment is parachuted simultaneously with his jump.
- Quick conversion to an ambulance plane capable of evacuating 34 stretcher cases with four attendants.
- Lowspeed landings and quick take-offs from ordinary airstrips.
- Fine flying characteristics, typical of all Fairchild aircraft.
- The only modern airplane being produced to *specifically* carry cargo.

BUY U.S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland

Trade-a-Plane Service, Crossville, Tenn., 3 issues per month, $0.25 yr.

U. S. Air Services, Transportation Bldg., Washington 6, D.C., M, $0.25, $3.00.

V.D.I. Zeitschrift, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., W, $19 yr.

Western Flying, 304 S. Broadway, Los Angeles 13, Calif., M, $0.25, $2.00.

Wings, McGraw-Hill Publishing Co., Inc., 330 W. 42d St., New York 18, N.Y., M.

Wings, 1 Marion St., Wellington, N.Z., M, 6*d*., 10*s*.

Society and University Publications

Accelerator, Metropolitan Section, Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, N.Y., 10 issues per yr.

Aero Mechanic, Aircraft Builders Lodge 751, A. F. of L., 5513 Airport Way, Seattle 8, Wash., W, $1.50.

Aeronautical Briefs, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 5, D.C., M.

Aeronautical Chamber of Commerce of America, Inc., Weekly Washington Bulletin, 610 Shoreham Bldg., Washington 5, D.C., W.

Aeronautical Engineering Review, Institute of the Aeronautical Sciences, Inc., 1505 RCA Bldg. West, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.30, $3.00.

The Air Force Woman, The National Assn. of Air Forces Women, 1702 K St., N.W., Washington 6, D.C., M.

The Air Line Mechanic, The Air Line Mechanics Assn., International, 155 N. Clark St., Chicago 1, Ill., M.

The Air Line Pilot, The Air Line Pilots Assn., International, 3145 W. 63d St., Chicago 29, Ill., M.

Airport Digest, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., M.

Airpost Journal, American Air Mail Society, Albion, Pa., M, $0.20, $2.00.

American Helicopter Society, Semi-Technical Bulletin, Newfield P.O. Box 4029, Bridgeport 7, Conn., Irreg., $0.50 per issue.

American Meteorological Society, Bulletin, Milton, Mass., M, $0.35, $3.50.

American Society for Testing Materials, Bulletin. 260 S. Broad St., Philadelphia 2, Pa., BM, $0.25, $1.50.

American Society of Mechanical Engineers, Transactions, 29 W. 39th St., New York 18, N.Y., M, $1.50, $12.

Army Ordnance, Army Ordnance Assn., 705 Mills Bldg., Washington 6, D.C., BM, $0.75, $4.50.

Astro-Jet, Glendale Rocket Society, 3262 Castera Ave., Glendale 8, Calif., 3 issues per yr., $1.00 yr.

Astronautics, American Rocket Society, 130 W. 42d St., New York, N.Y., Irreg., $3.00 yr.

Automotive War Production, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich., M.

Aviation Progress, County Chamber of Commerce, Los Angeles, Calif., M.

Aviation Writers Assn., Newsletter, P.O. Box 856, Grand Central Annex, New York 17, N.Y., Irreg.

Boletín de Aviación, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., M.

Chirp, The Early Birds, Lt. Col. Ernest Jones, Secretary, 3401 16th St., N.W., Washington, D.C., Irreg.

Conference of International Air Traffic Operators, Bulletin, 31-32, Haymarket, London, S.W.1, M, 1*s*., 10*s*. 6*d*.

Electrical Engineering, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N.Y., M, $1.50, $12.

Faraday Society, Transactions, 98 Great Russell Street, London, W.C.1, M, 5*s*. per issue.

Fasteners, American Institute of Bolt, Nut and Rivet Manufacturers, 1550 Hanna Bldg., Cleveland 15, Ohio, Q.

For Your Information, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., W.

The Foundation, Engineering Society of Detroit, 100 Farnsworth Ave., Detroit, Mich., M.

The Franklin Institute, Journal, Benjamin Franklin Parkway at 20th St., Philadelphia, Pa., M, $0.60, $6.00.

Haul Down and Ease Off, National Assn. of American Balloon Corps Veterans, P.O. Box 2040, Wichita, Kan., BM.

Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill., M, $0.25, $2.00.

Institute of Radio Engineers, Proceedings, 330 W. 42d St., New York 18, N.Y., M, $1.00, $10.

Institute of Transport, Journal, 15 Savoy St., Victoria Embankment, London, W.C.2, Q, 2*s*. 6*d*. per issue.

The Institute of Welding, Transactions, 2, Buckingham Palace Gardens, London, S.W.1, Q, 10*s*. 6*d*. per issue.

Journal of Aeronautical Meteorology, Meteorological Committee, Air Transport Association of America, 10 Richards Road, Kansas City 6, Mo., Q, $0.50, $2.00.

Journal of Applied Mechanics, 29 W. 39th St., New York 18, N.Y., Q, $1.35, $5.00.

Journal of Applied Physics, 57 E. 55th St., New York 22, M, $0.70, $7.00.

The Journal of Engineering Education, Prince and Lemon Sts., Lancaster, Pa., 10 issues per year, $0.50, $3.00.

The Journal of Meteorology, American Meteorological Society, Milton 86, Mass., Q, $6.00 yr.

Journal of Scientific Instruments, The University, Reading, Berkshire, England, M, 3*s*. 4*d*., 40*s*.

Journal of the Aeronautical Sciences, Institute of the Aeronautical Sciences, Inc., 1505 RCA Bldg. West, 30 Rockefeller Plaza, New York 20, N.Y., Q, $2.00, $7.00.

Mechanical Engineering, American Society of Mechanical Engineers, Inc., 29 W. 39th St., New York 18, N.Y., M, $0.75, $6.00.

Metropolitan Airmail Cover Club, Bulletin, The Malin Studios, 225 W. 46th St., New York 19, N.Y., M.

Model Aviation, Air Youth Div., National Aeronautic Assn., 1025 Connecticut Ave., Washington 6, D.C., M, $1.00.

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New York University, Contributions from the College of Engineering, University Heights, New York 53, N.Y., Irreg.

Ohio State University, Engineering Experiment Station, News, Columbus, Ohio, M.

Pacific Aeronautical Library, Check-List, 6715 Hollywood Blvd., Los Angeles 28, Calif., Irreg.

Photogrammetric Engineering, The American Society of Photogrammetry, P.O. Box 18, Benjamin Franklin Sta., Washington, D.C., $1.50 per issue.

Planes, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 5, D.C., M.

Polish Engineering Review, Association of Polish Engineers in Canada, 3432 Drummond St., Montreal, Quebec, BM, $0.50, $3.00.

Press Summary, Society of British Aircraft Constructors, Ltd., 32, Saville Row, London, W.1, W.

Production Information, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich., M.

Quarterly of Applied Mathematics, Brown University, Providence 12, R.I., Q, $2.00, $6.00.

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Royal Aeronautical Society, Journal, 4, Hamilton Place, London, W.1, M, 7*s*. 6*d*., £4 10*s*.

Royal Meteorological Society, Quarterly Journal, 49, Cromwell Rd., London, S.W.7, Q, 7*s*. 6*d*. per issue.

SAE Journal, Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, N.Y., M, $1.00, $10.

Soaring, Soaring Society of America, Inc., Elmira, N.Y., BM, $4.00 yr.

Sociedad Cubana de Ciencias Físicas y Matemáticas, Revista, Habana, Cuba, Irreg., $0.50, $3.00 per vol. of 6 issues.

Standards Review, British Standards Instn., 28 Victoria St., Westminster, London, S.W.1, Q, 2*s*., 7*s*.

The Thermal, The Southern California Soaring Assn., Inc., 453 S. Spring St., Los Angeles 13, Calif., M, $2.00 yr.

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Warplane Production, Aircraft War Production Council, Inc., 7046 Hollywood Blvd., Los Angeles 28, Calif., BM.

Weight Engineering, Society of Aeronautical Weight Engineers, Inc., 143 N. Brand Blvd., Glendale 3, Calif., Q, $0.50, $1.75.

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Wings Club, Inc., Bulletin, 50 Vanderbilt Ave., New York 17, N.Y., M.

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Aerodrome Abstracts, compiled by the Department of Scientific and Industrial Research and issued in collaboration with the Air Ministry, The Institution of Civil Engineers, St. George St., Westminster, London, S.W.1, M.

Aeronáutica, Clasificador F-468, Santiago de Chile, M, $6.00 (pesos), $50 (pesos).

Air Force, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

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Army News, Bureau of Public Relations, War Dept., Washington 25, D.C., SM.

Australia, Council for Aeronautics, Reports, Box 4331, G.P.O., Melbourne, Irreg.

Bulletin of War Medicine, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.40, $4.65.

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Gt. Brit., Air Registration Board, Notice to Licensed Aircraft Engineers and to Owners of Civil Aircraft, Brettenham House, Strand, London, W.C.2, Irreg.

Gt. Brit., Ministry of Aircraft Production, Abstracts from the Scientific and Technical Press, and Titles and References of Articles and Papers Selected from Publications (Reviewed by R.T.P. 3), Together with List of Selected Translations, The Royal Aeronautical Society, 4, Hamilton Place, London, W.1, M.

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Bell Laboratories Record, 463 West St., New York 14, N.Y., M, $2.00 yr.

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Cessquire, Cessna Aircraft Co., Wichita, Kan., M.

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Chicago Douglas Airview News, Douglas Aircraft Co., Inc., Park Ridge, Ill., W.

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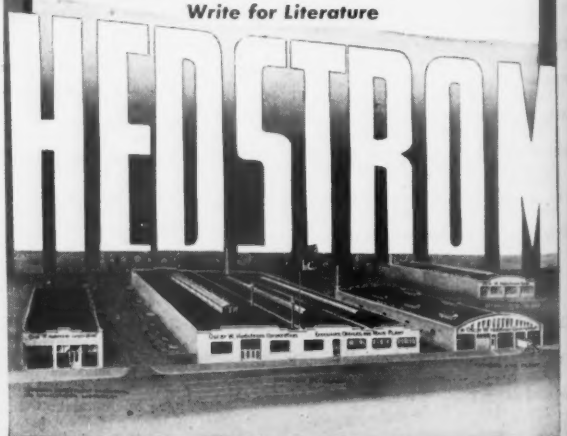

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